Conflict of Interest and Funding

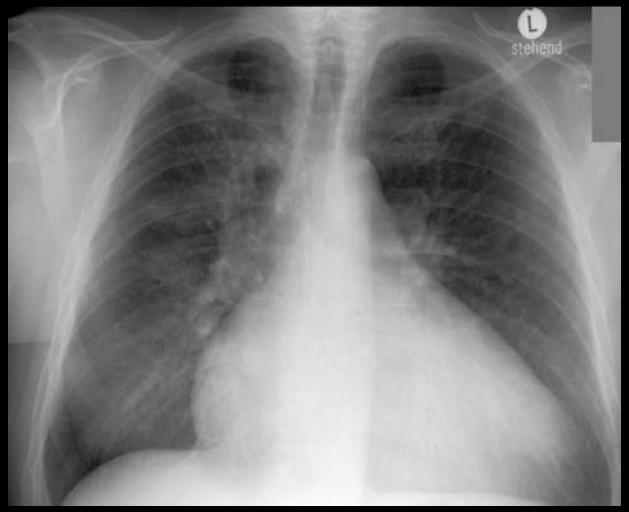
- Speaking honorarium: MEDA pharma, Boehringer Ingelheim
- Consulting fees: St Jude Medical

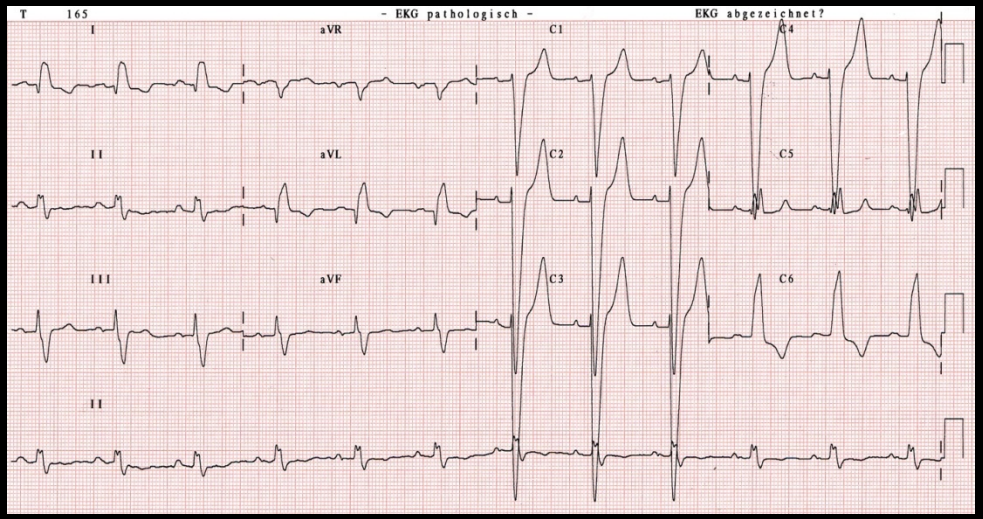
Who Should NOT get a Cardiac Resynchronization Therapy in 2013 ?

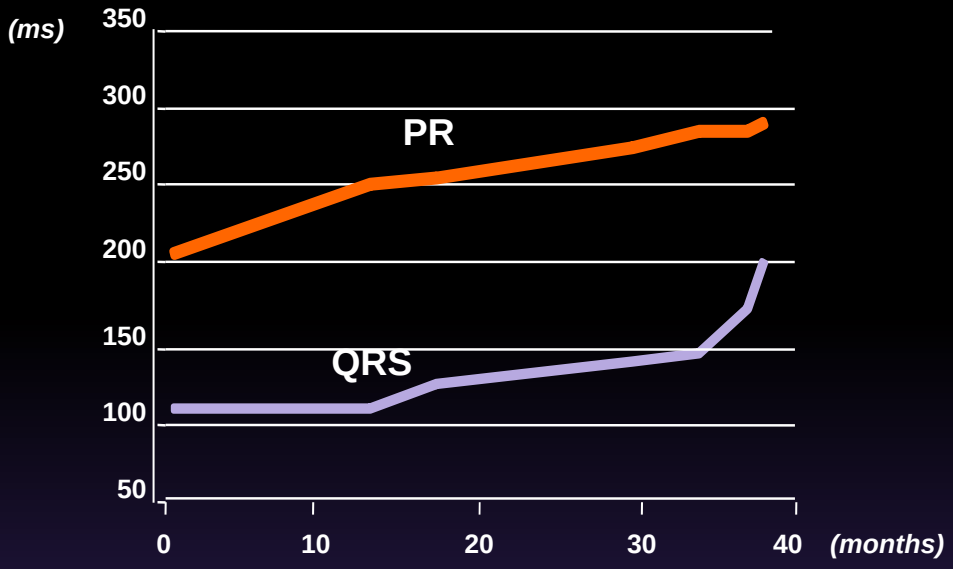
Nicolas Derval, MD

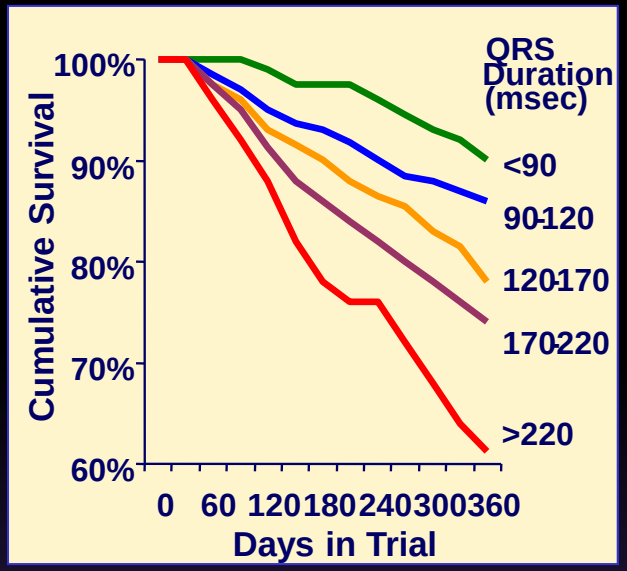
Hôpital Cardiologique du Haut-Lévêque
Bordeaux, France

Electrical dyssynchrony in heart failure









Adapted from Gottipaty et al.

Study (n)	NYHA	QRS	Sinus	ICD?	Status	Results
PATH CHF (41)	III, IV	▢120	Normal	No	Published	+
MUSTIC SR (58)	III	▢150	Normal	No	Published	+

+ 4000 pts included in large trials
Improvement of Quality of Life, NYHA status, 6MWT, peak VO2
Reduction of Mortality, Hospitalizations

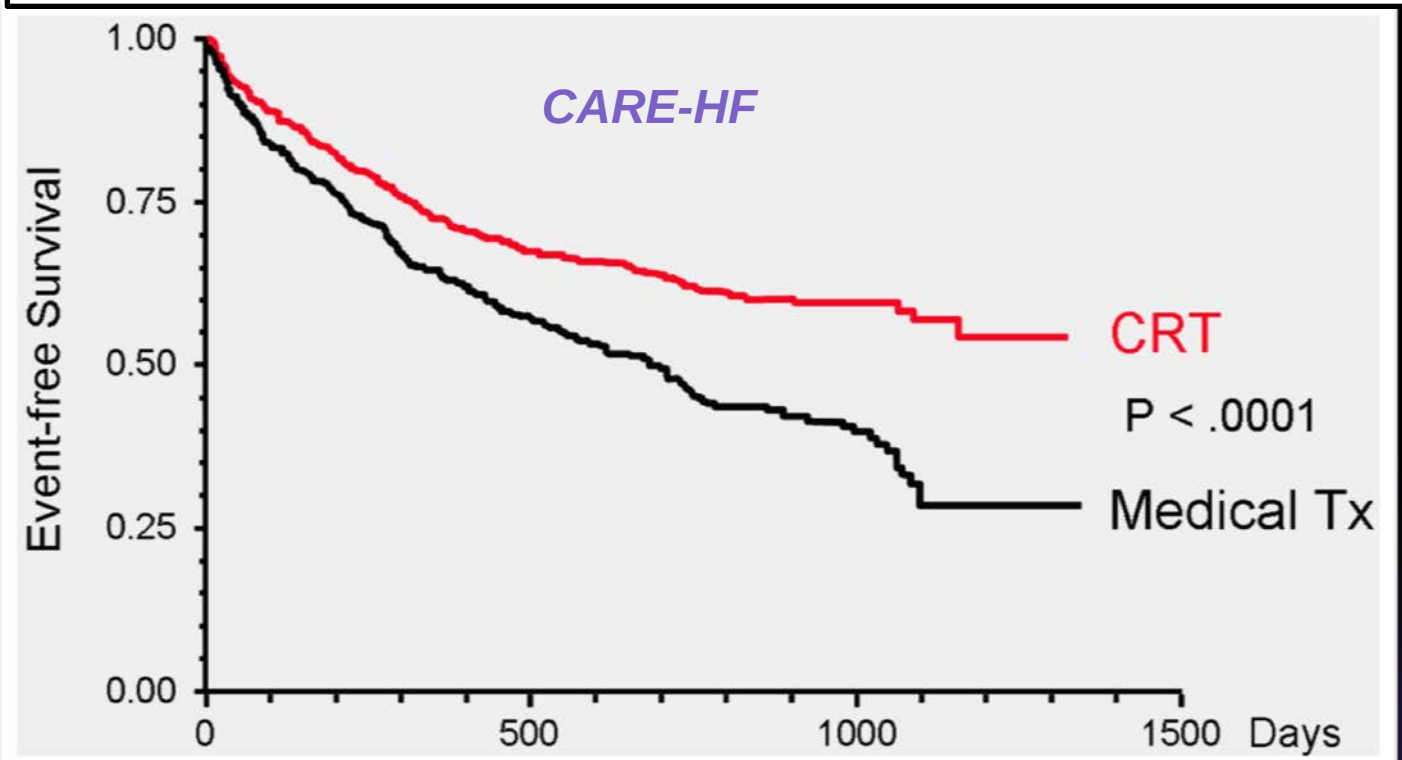
COMPANION (1520)	**III, IV**	**▢120**	**Normal**	**No**	**Published**	**+**
CARE HF (814)	**III, IV**	**▢120†**	**Normal**	**No**	**Published**	**+**
REVERSE (610)	**I, II**	**▢120**	**Normal**	**Y/N**	**Published**	**+ / -**
MADIT CRT (1820)	**I, II**	**≥ 130**	**Normal**	**Yes**	**Published**	**+**
RAFT (1798)	**II, III**	**≥ 120 or 200 if paced**	**SR, AF**	**Yes**	**Published**	**+**

2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy

The Task Force on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA).

2013

Recommendations	Class [a]	Level [b]	Ref. [c]
1) LBBB with QRS duration >150 ms. CRT is recommended in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment. [d]	I	A	48–64
2) LBBB with QRS duration 120–150 ms. CRT is recommended in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment. [d]	I	B	48–64



Cleland. N Engl J Med. 2005

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EUROPEAN SOCIETY OF CARDIOLOGY®

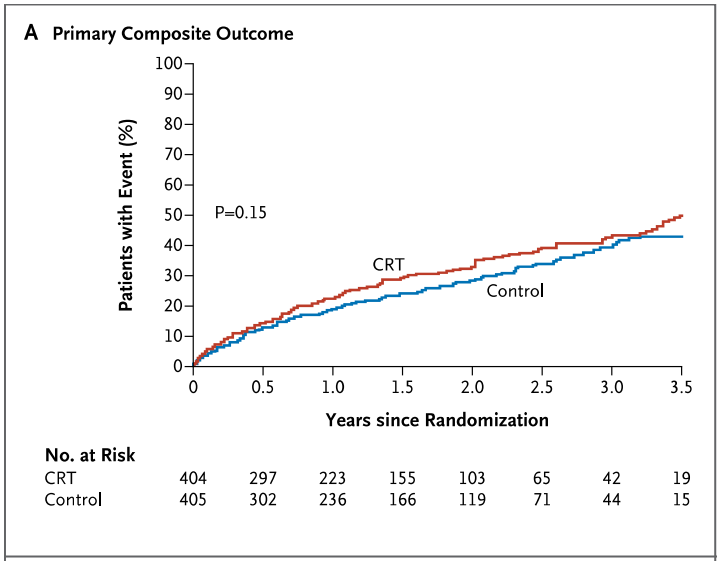
Recommendations	Class [a]	Level [b]	Ref. [C]
3) Non-LBBB with QRS duration >150 ms. CRT should be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment. [d]	IIa	B	48–64
4) Non-LBBB with QRS duration 120–150 ms. CRT may be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment. [d]	IIb	B	48–64

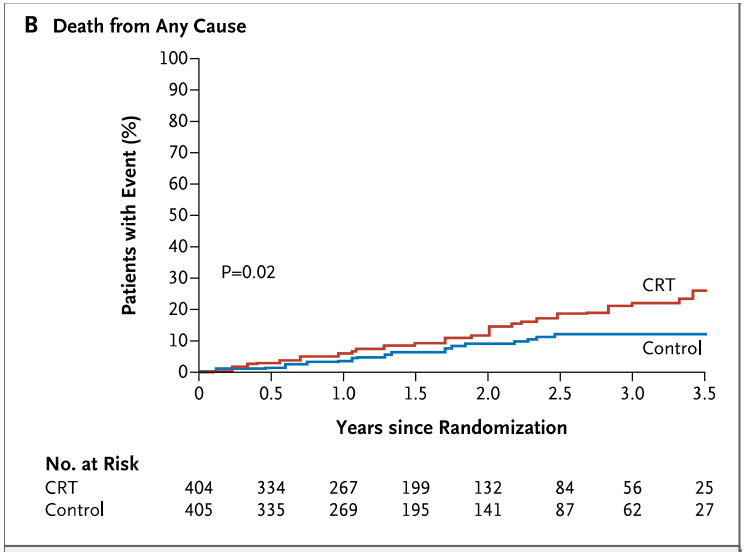
ORIGINAL ARTICLE

Cardiac-Resynchronization Therapy in Heart Failure with a Narrow QRS Complex

Frank Ruschitzka, M.D., William T. Abraham, M.D., Jagmeet P. Singh, M.D., Ph.D., Jeroen J. Bax, M.D., Ph.D., Jeffrey S. Borer, M.D., Josep Brugada, M.D., Ph.D., Kenneth Dickstein, M.D., Ph.D., Ian Ford, M.D., Ph.D., John Gorcsan III, M.D., Daniel Gras, M.D., Henry Krum, M.B., B.S., Ph.D., Peter Sogaard, M.D., D.M.Sc., and Johannes Holzmeister, M.D., for the EchoCRT Study Group*

- Randomized, multicenter (115)
- Patients with HF, class III/IV
- QRS duration <130ms
- Echocardiographic evidence of LV dyssynchrony
- Stopped on March 2013
- 809 patients





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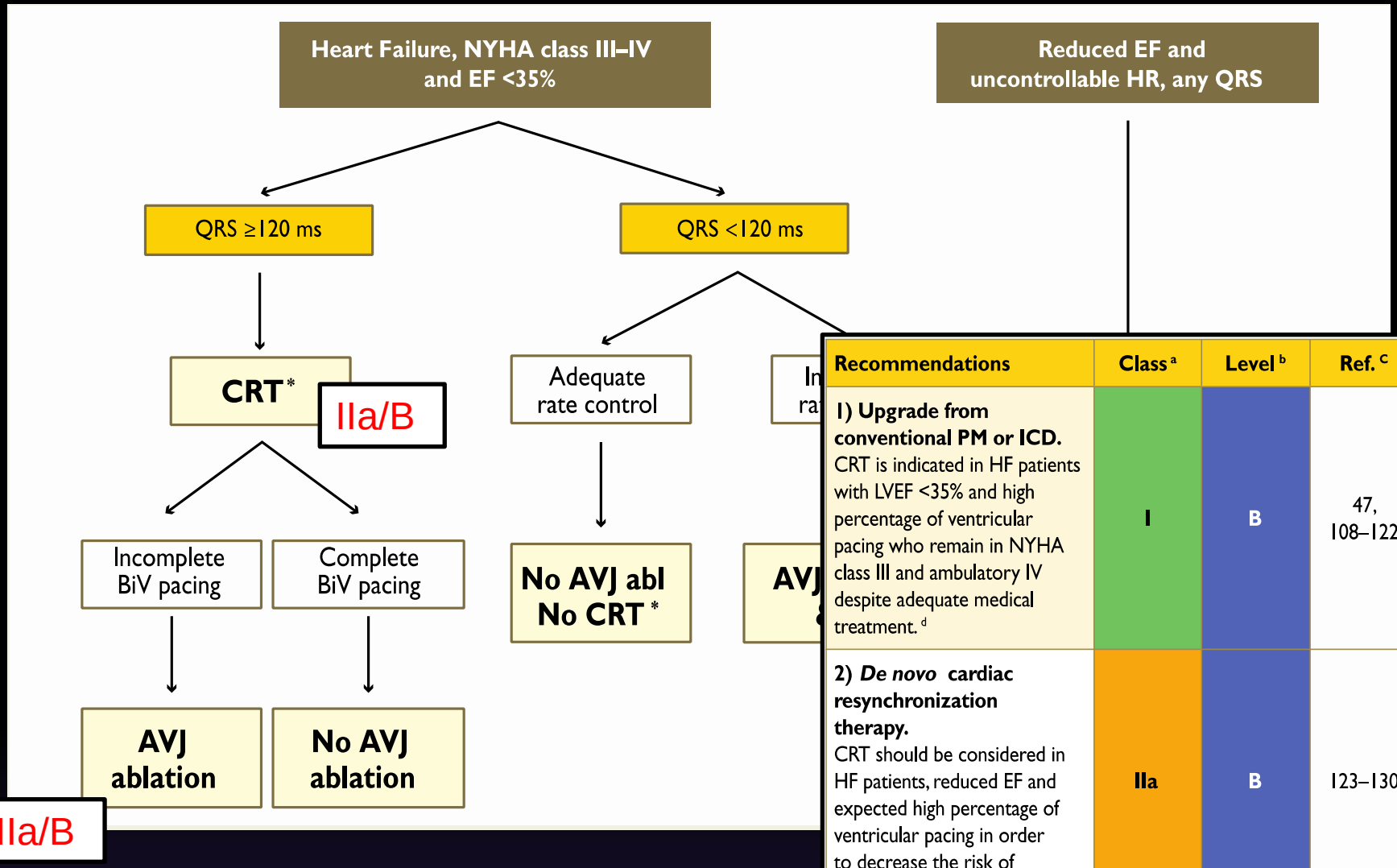
Recommendations	Class [a]	Level [b]	Ref. [C]
3) Non-LBBB with QRS duration >150 ms. CRT should be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical tre	IIa	B	48–64
4) Non-LBBB with QRS duration 120–150 ms. CRT may be considered in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment [d]	IIb	B	48–64

Recommendations	Class [a]	Level [b]	Ref. [C]
5) CRT in patients with chronic HF with QRS duration <120 ms is not recommended.	III	B	65, 66

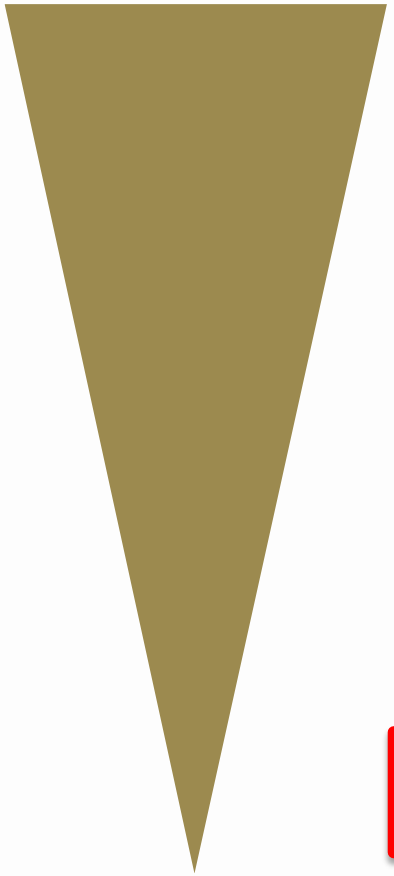
Recommendations in patients with heart failure and permanent atrial fibrillation



Recommendations	Class [a]	Level [b]	Ref. [c]
1) Upgrade from conventional PM or ICD. CRT is indicated in HF patients with LVEF <35% and high percentage of ventricular pacing who remain in NYHA class III and ambulatory IV despite adequate medical treatment. [d]	I	B	47, 108–122
2) *De novo* cardiac resynchronization therapy. CRT should be considered in HF patients, reduced EF and expected high percentage of ventricular pacing in order to decrease the risk of worsening HF.	IIa	B	123–130

Magnitude of benefit from CRT

Highest (responders)



Wider QRS, left bundle branch block, females, non-ischaemic cardiomyopathy

Males, ischaemic cardiomyopathy

Narrower QRS, non-left bundle branch block

Lowest (non-responders)

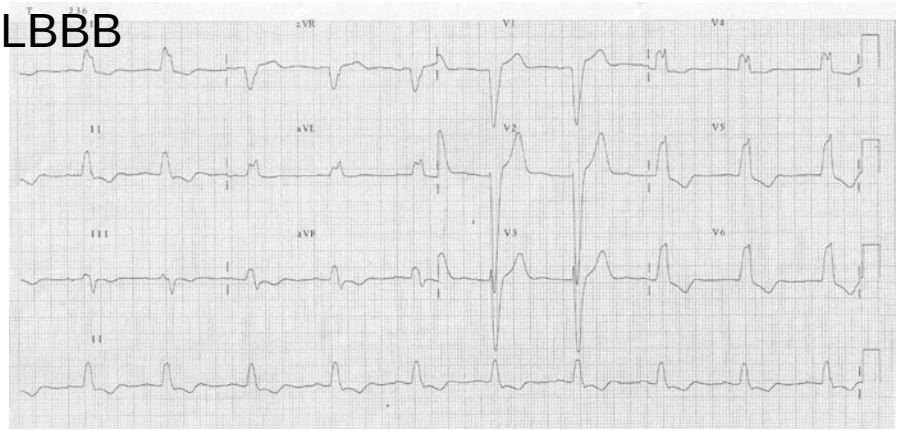
AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part III: Intraventricular Conduction Disturbances

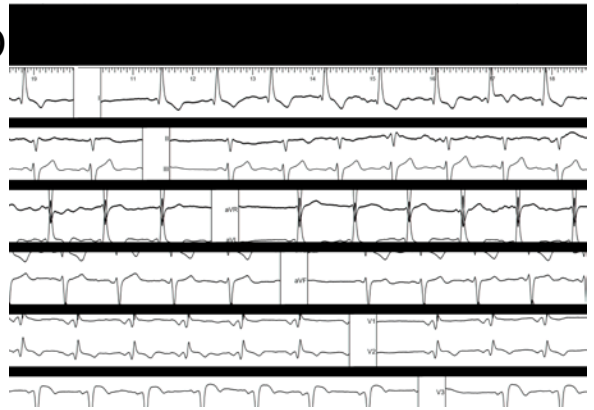
Complete LBBB

1. QRS duration greater than or equal to 120 ms in adults, greater than 100 ms in children 4 to 16 years of age, and greater than 90 ms in children less than 4 years of age.
2. Broad notched or slurred R wave in leads I, aVL, V_5, and V_6 and an occasional RS pattern in V_5 and V_6 attributed to displaced transition of QRS complex.
3. Absent q waves in leads I, V_5, and V_6, but in the lead aVL, a narrow q wave may be present in the absence of myocardial pathology.
4. R peak time greater than 60 ms in leads V_5 and V_6 but normal in leads V_1, V_2, and V_3, when small initial r waves can be discerned in the above leads.
5. ST and T waves usually opposite in direction to QRS.
6. Positive T wave in leads with upright QRS may be normal (positive concordance).
7. Depressed ST segment and/or negative T wave in leads with negative QRS (negative concordance) are abnormal (11,12) and are discussed in part VI of this statement.
8. The appearance of LBBB may change the mean QRS axis in the frontal plane to the right, to the left, or to a superior, in some cases in a rate-dependent manner (13,14).

LBBB



NIVCD



LV activation pattern in patients with narrow QRS, NICD or LBBB

47 heart failure patients referred for catheter ablation of VT

Narrow QRS: n=19

Nonspecific intraventricular conduction disturbance: n=16

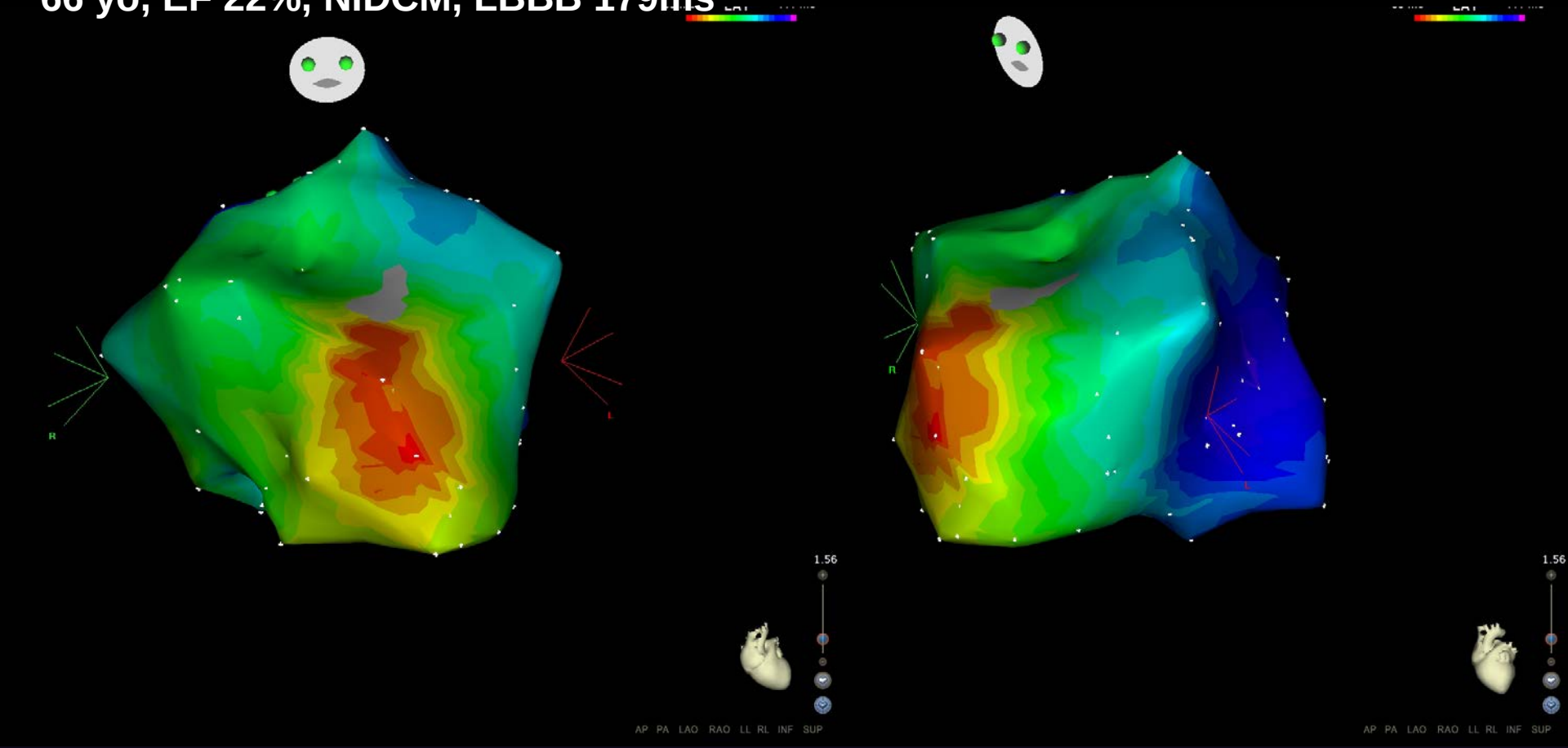
Left bundle branch block: n=12

3D navigation system

Abstract HRS 2013. Derval et

LBBB: preliminary results

66 yo, EF 22%, NIDCM, LBBB 179ms



LBBB: preliminary results

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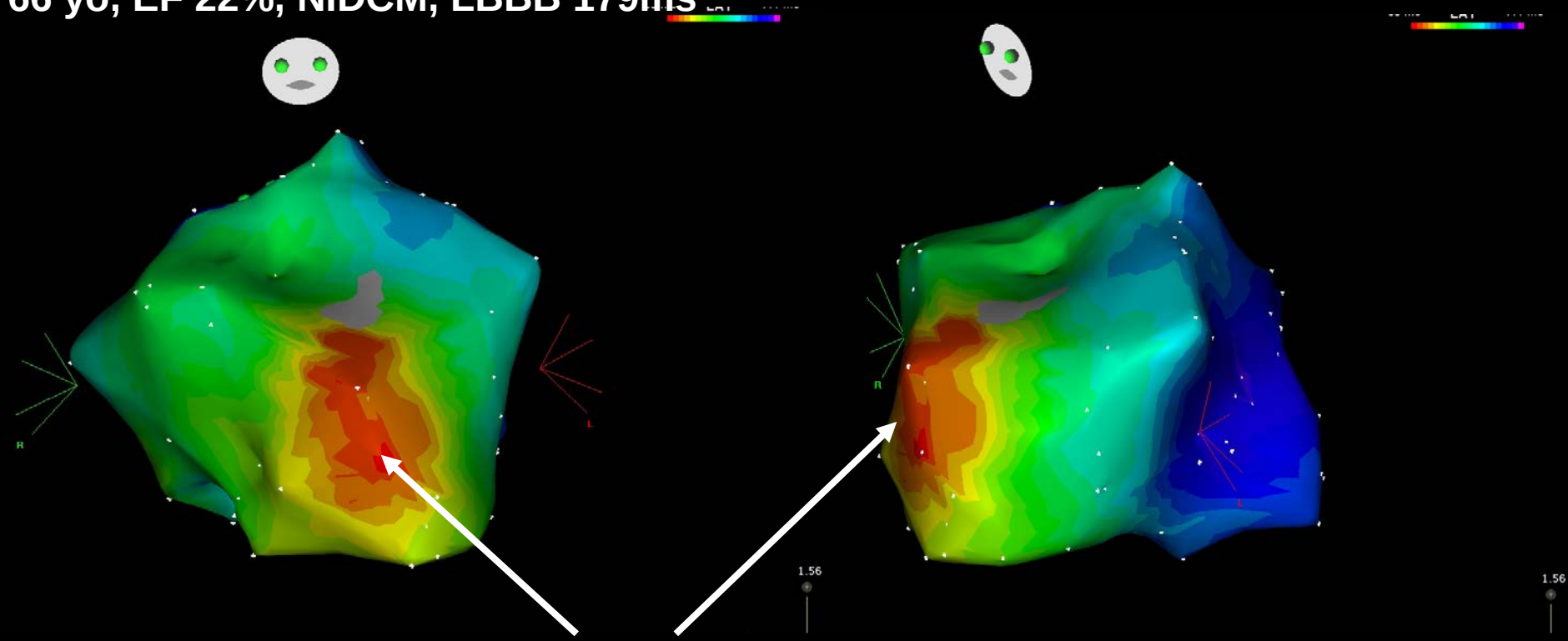
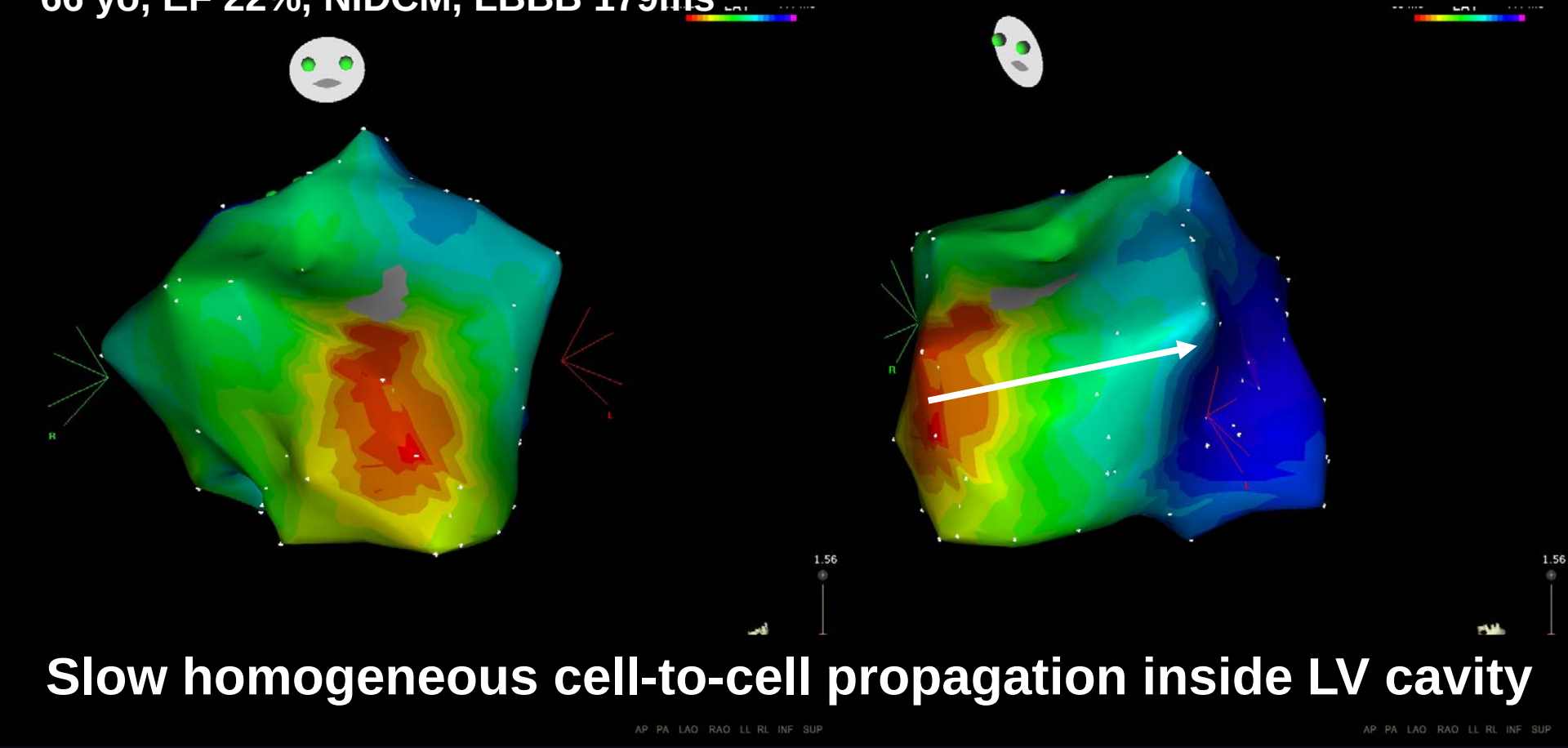


Single LV breakthrough in the septum
43±20 ms after the beginning of the QRS complex
Prolonged right-to-left transseptal activation time
Absence of direct LV Purkinje activation

LBBB: preliminary results

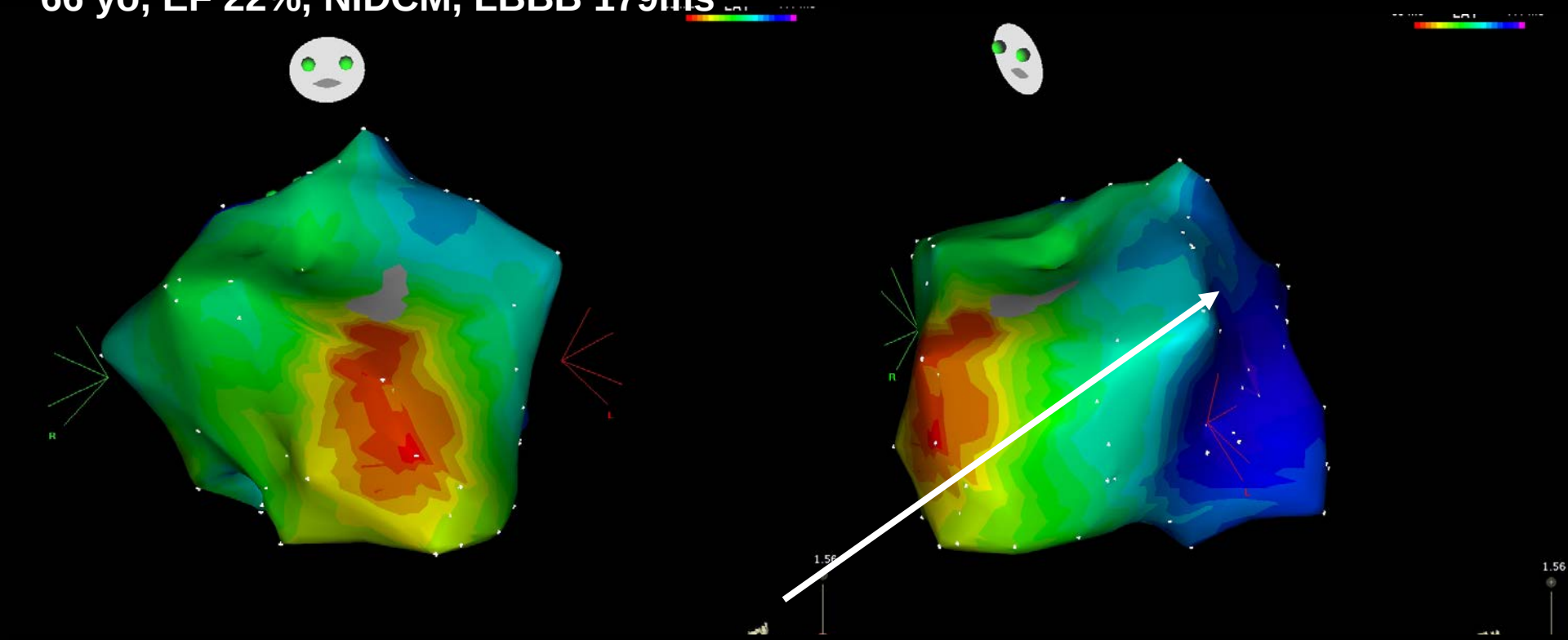
66 yo, EF 22%, NIDCM, LBBB 179ms



Slow homogeneous cell-to-cell propagation inside LV cavity

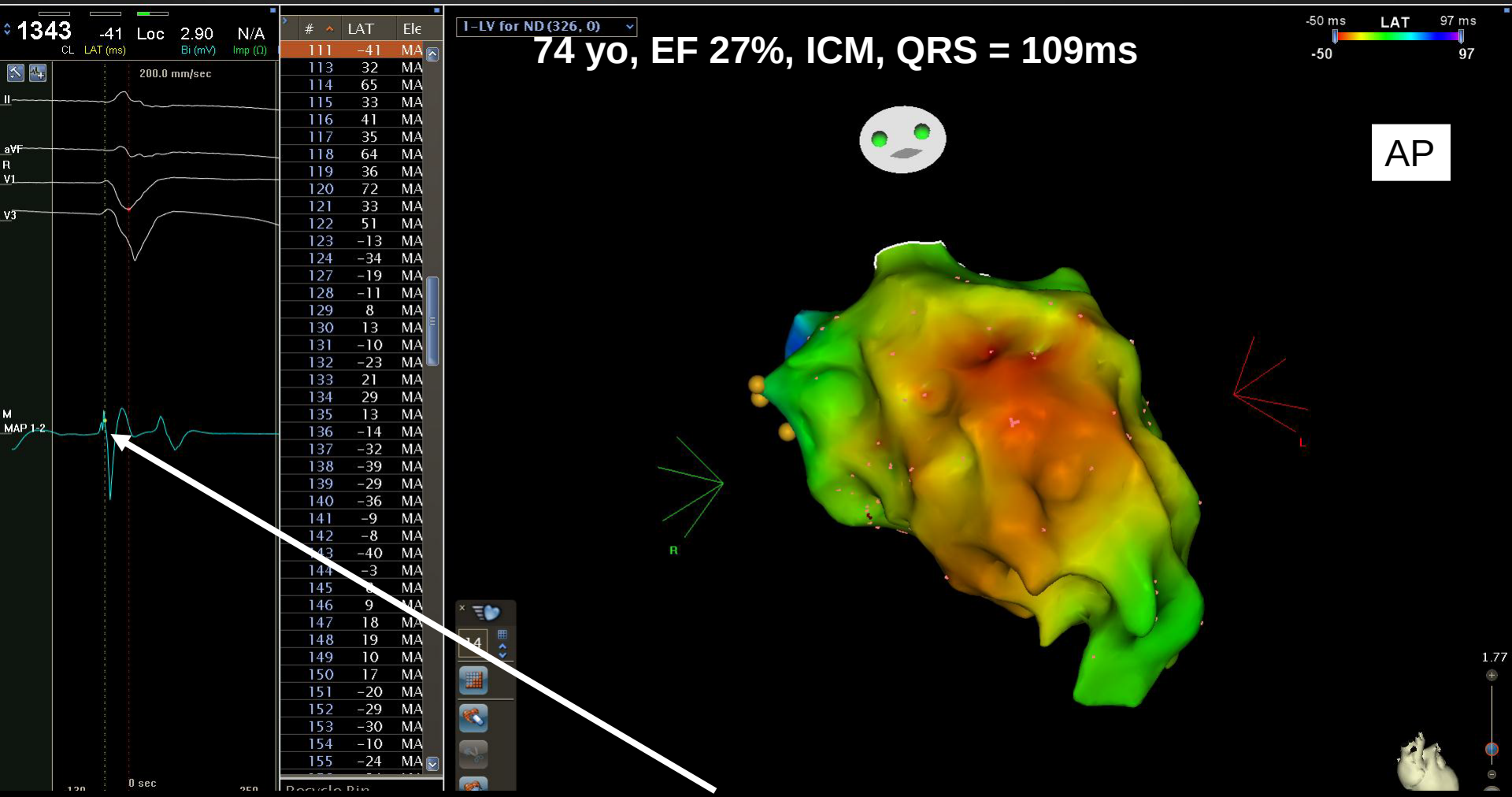
LBBB: preliminary results

66 yo, EF 22%, NIDCM, LBBB 179ms



Basal lateral wall as the latest activated region

Narrow QRS: preliminary results

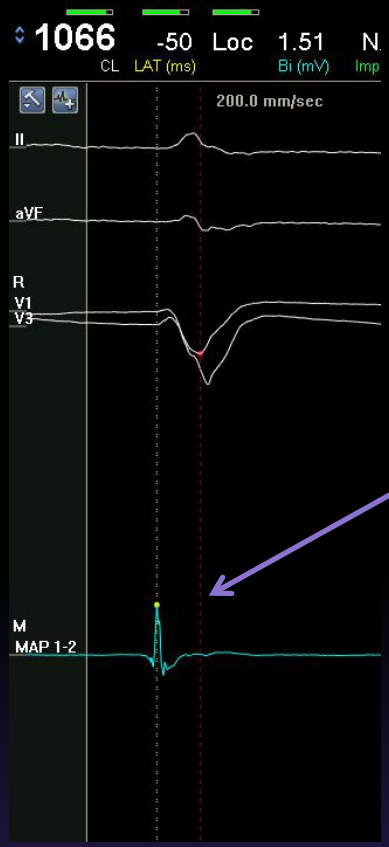


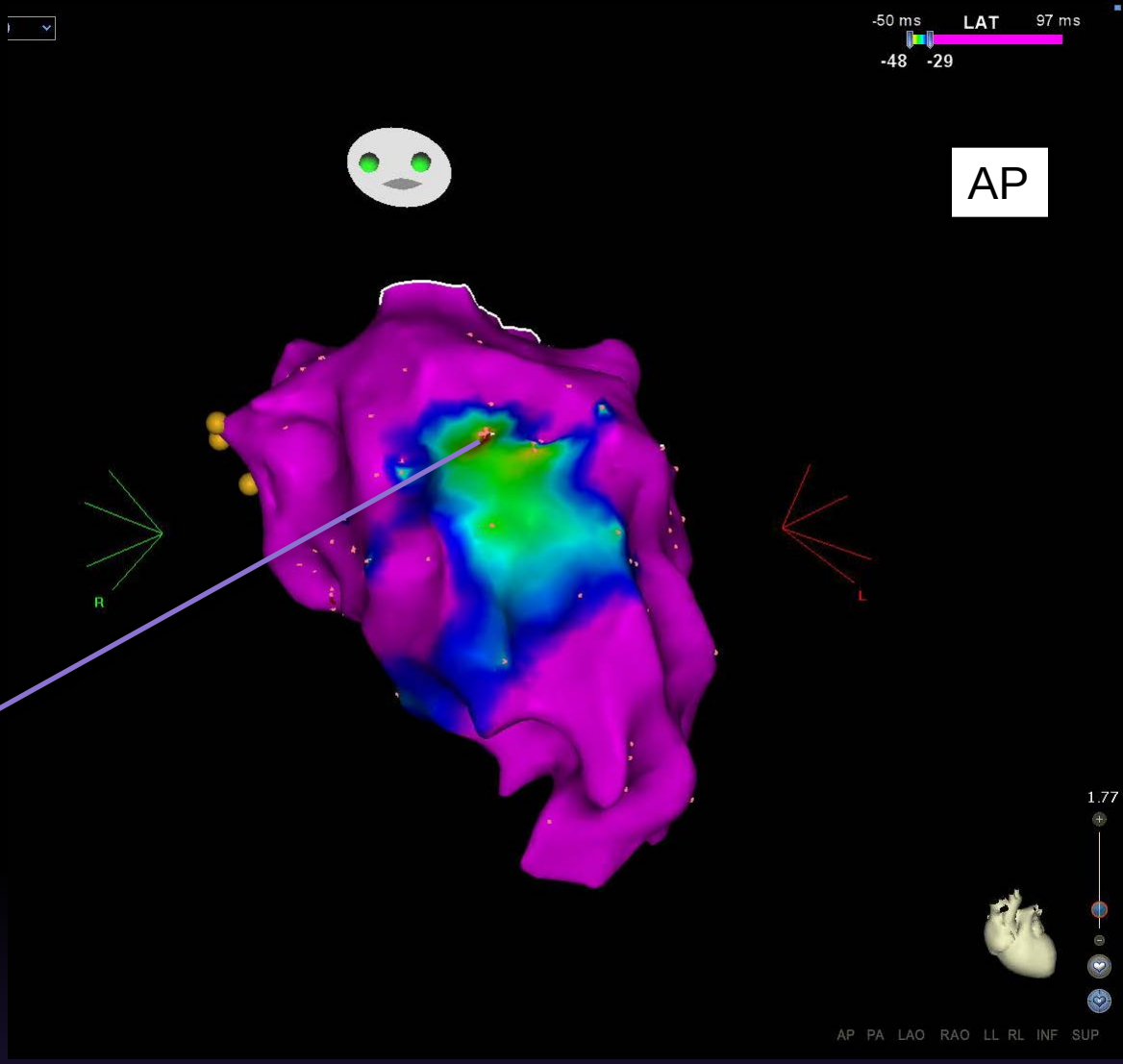
Multiple LV breakthrough (4±2)

Recording of early/preQRS LV EGMs with Purkinje potentials

Narrow QRS: preliminary results

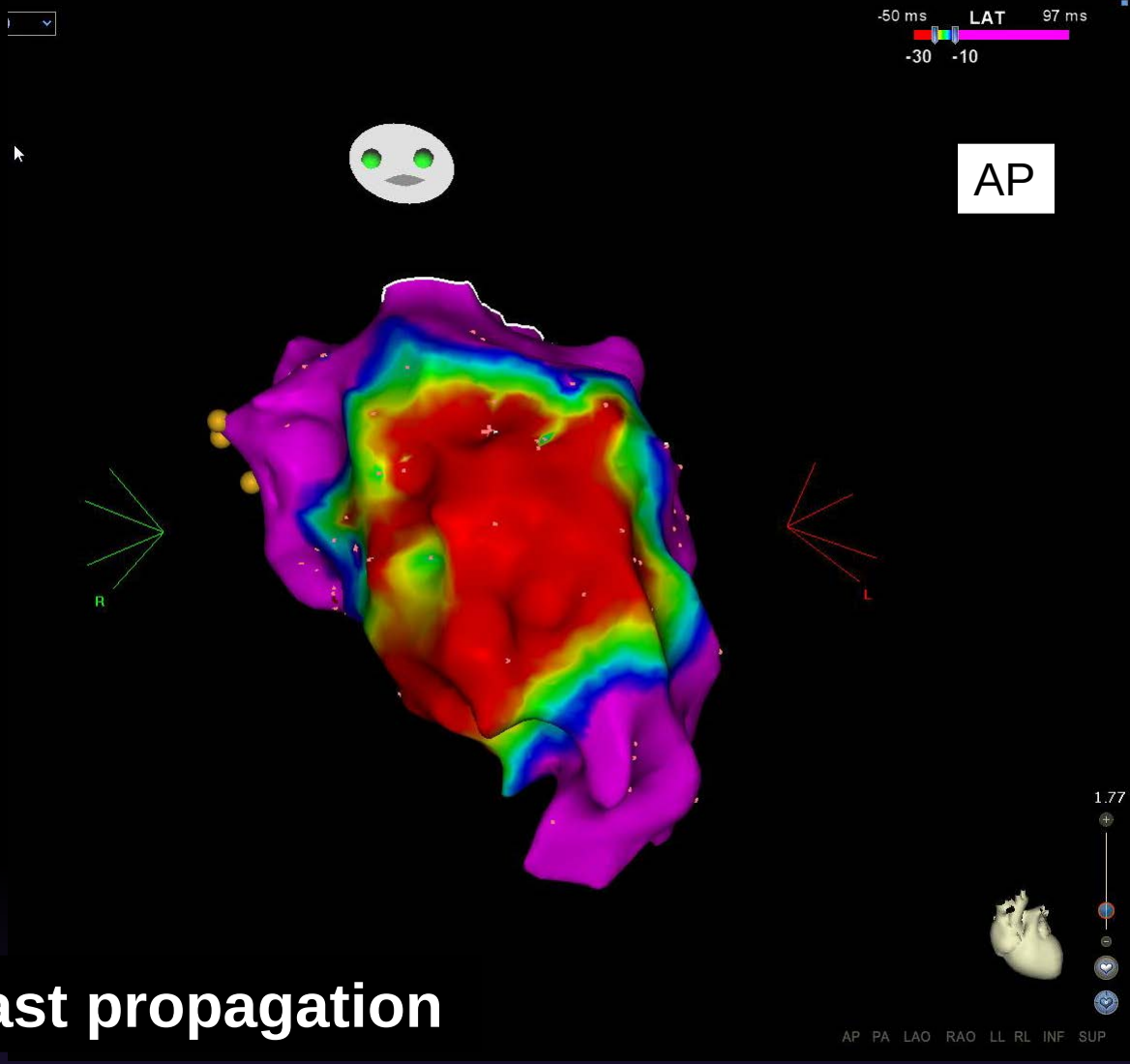
T= 0 à 20ms





Narrow QRS: preliminary results

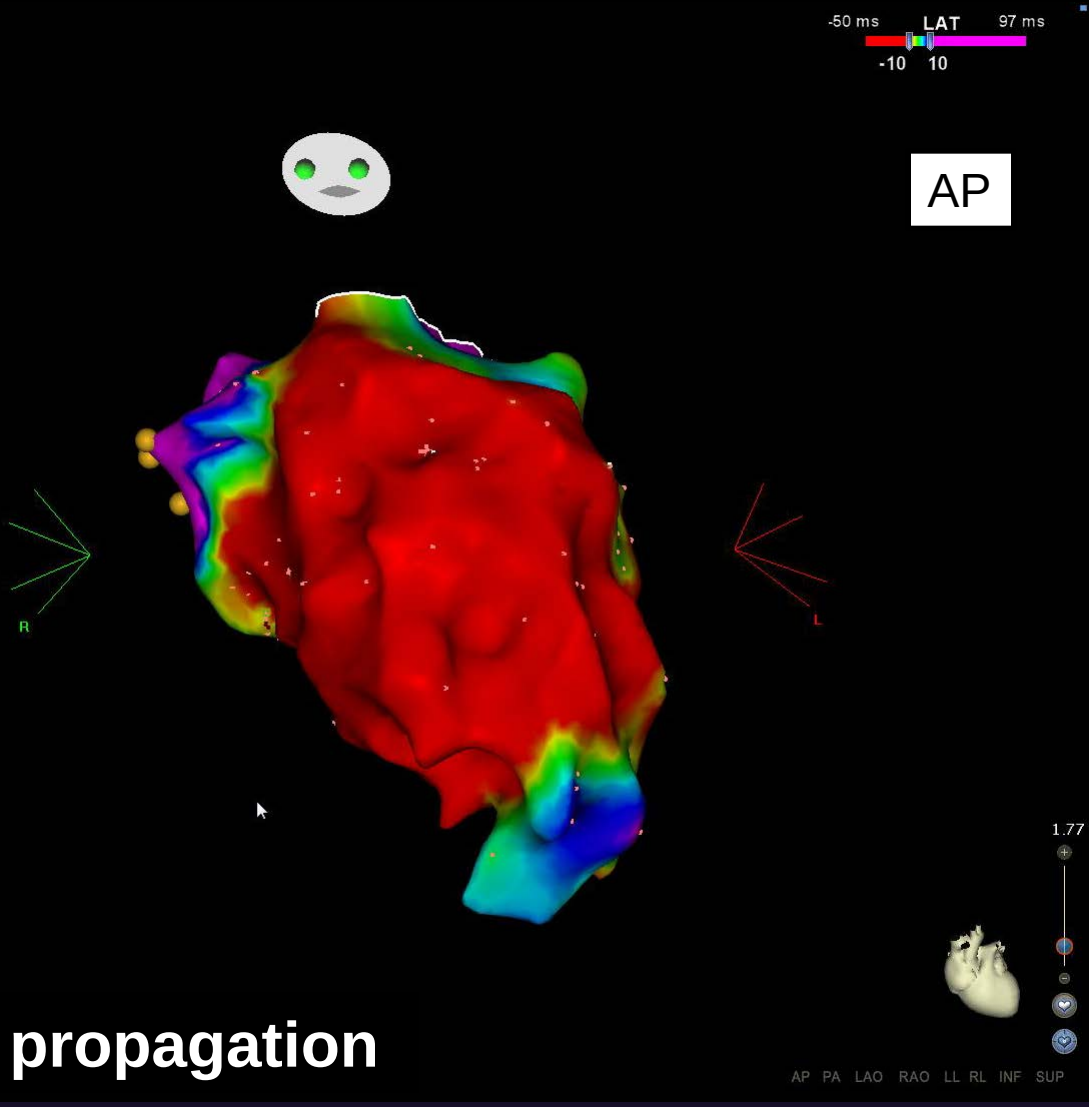
T= 20 à 40ms



Fast propagation

Narrow QRS: preliminary results

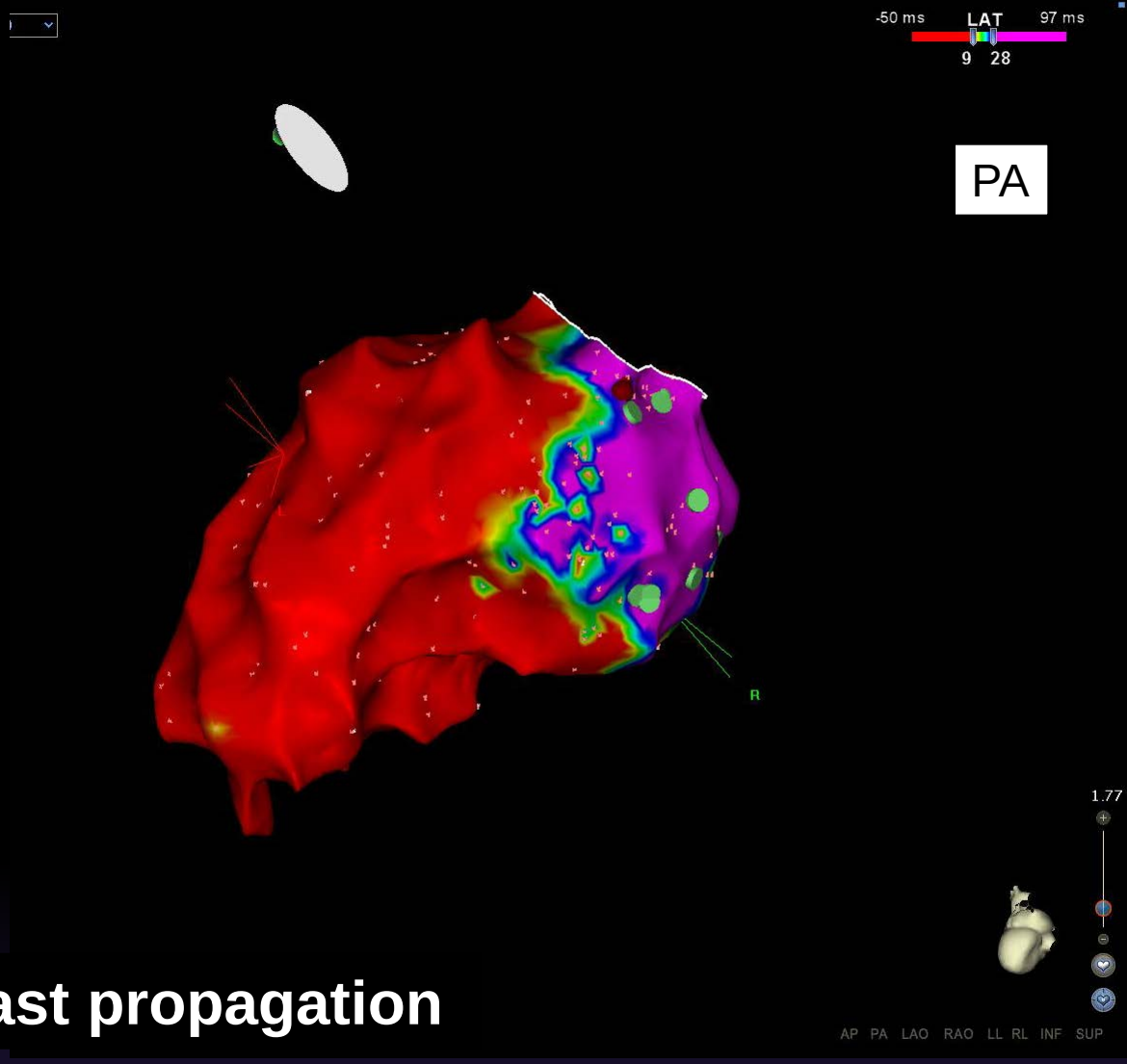
T= 40 à 60ms



Fast propagation

Narrow QRS: preliminary results

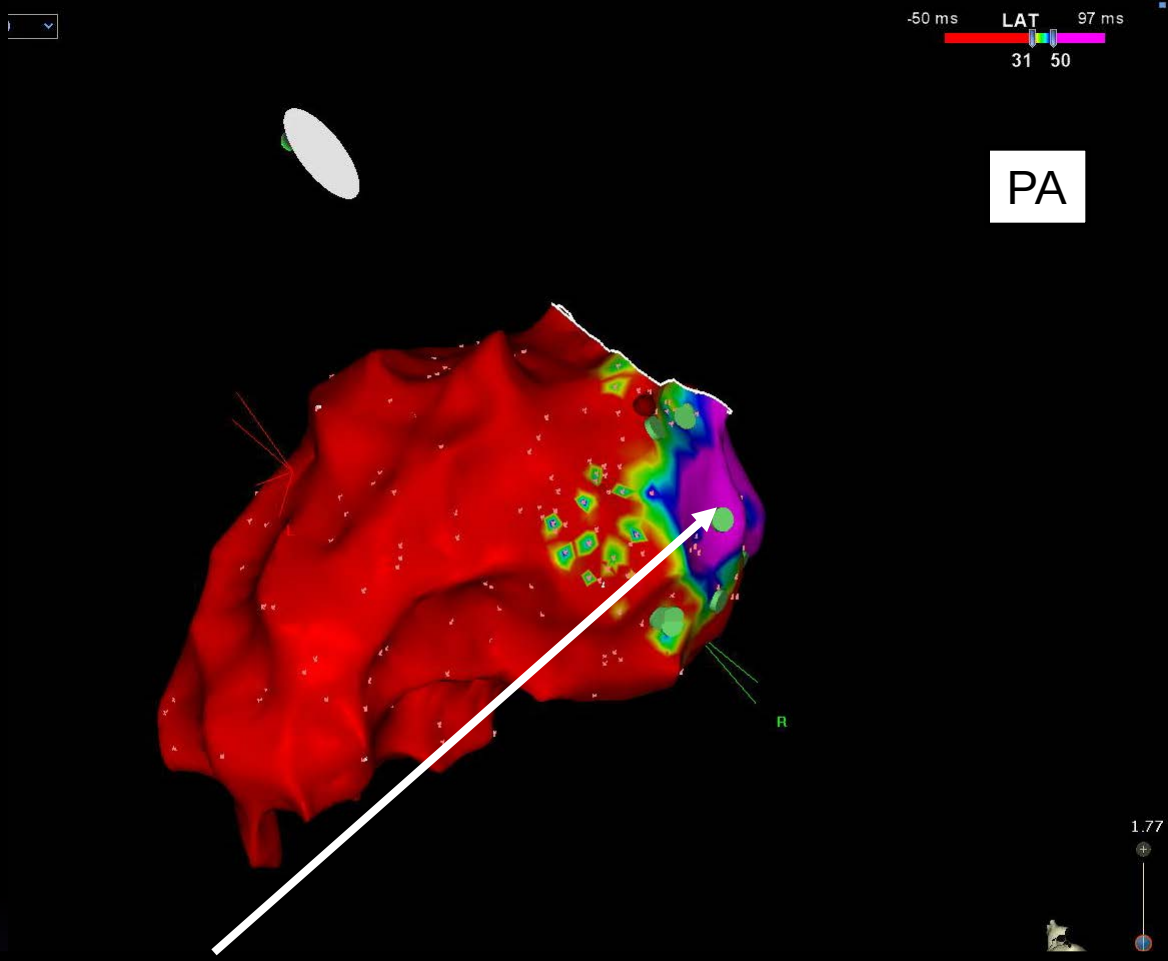
T= 60 à 80ms



Fast propagation

Narrow QRS: preliminary results

T= 80 à 100ms

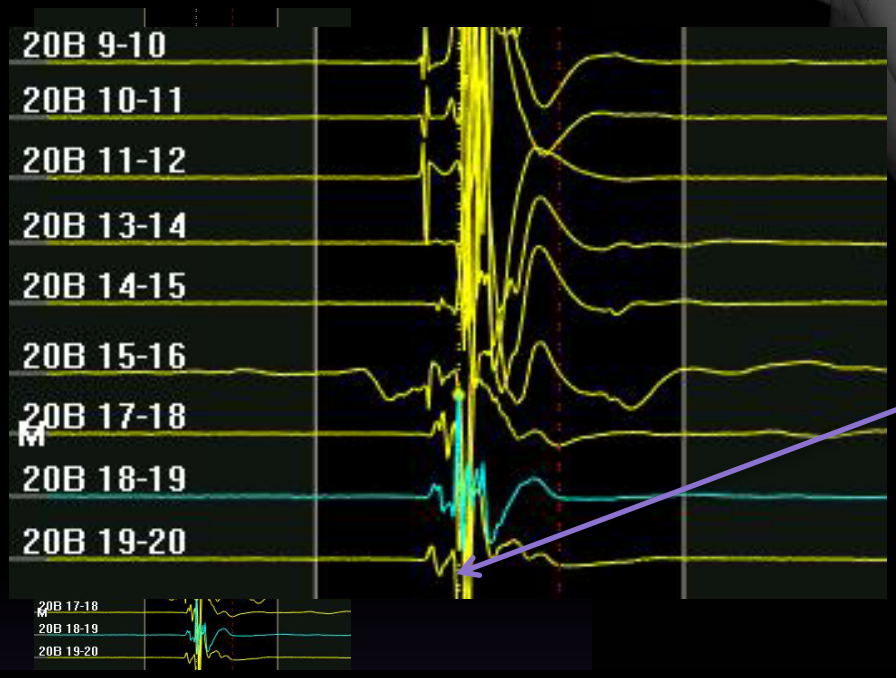


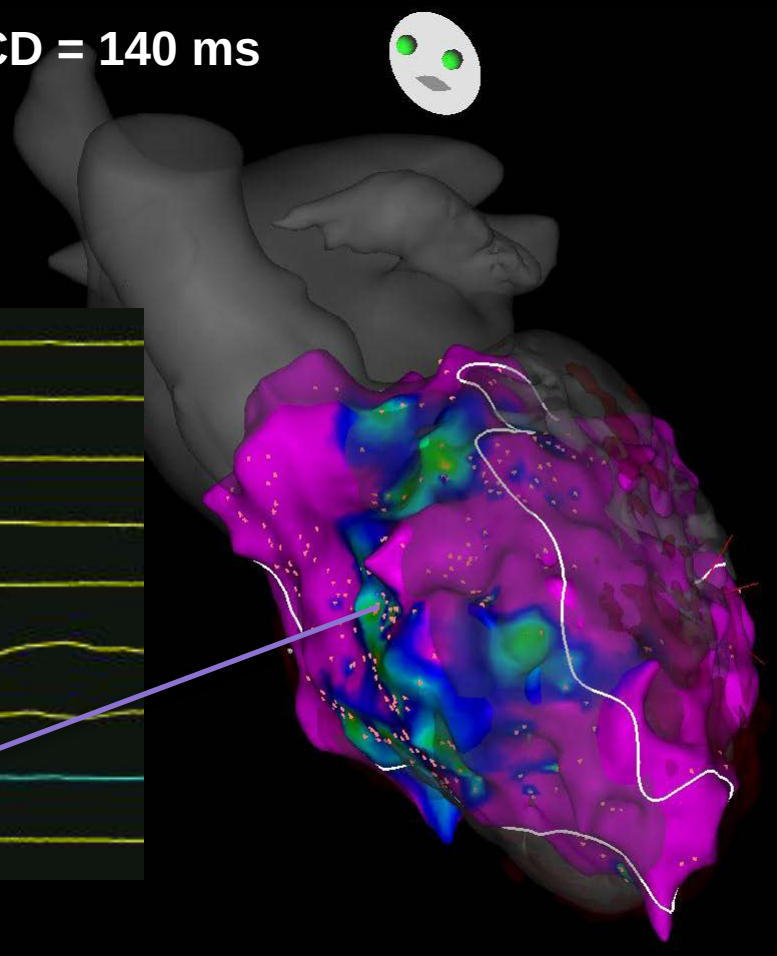
Limited areas of late activation
Interindividual heterogeneity in terms of late activated areas

NICD: preliminary results

71 yo, EF 25%, ICM, NICD = 140 ms

T= 0 à 20ms



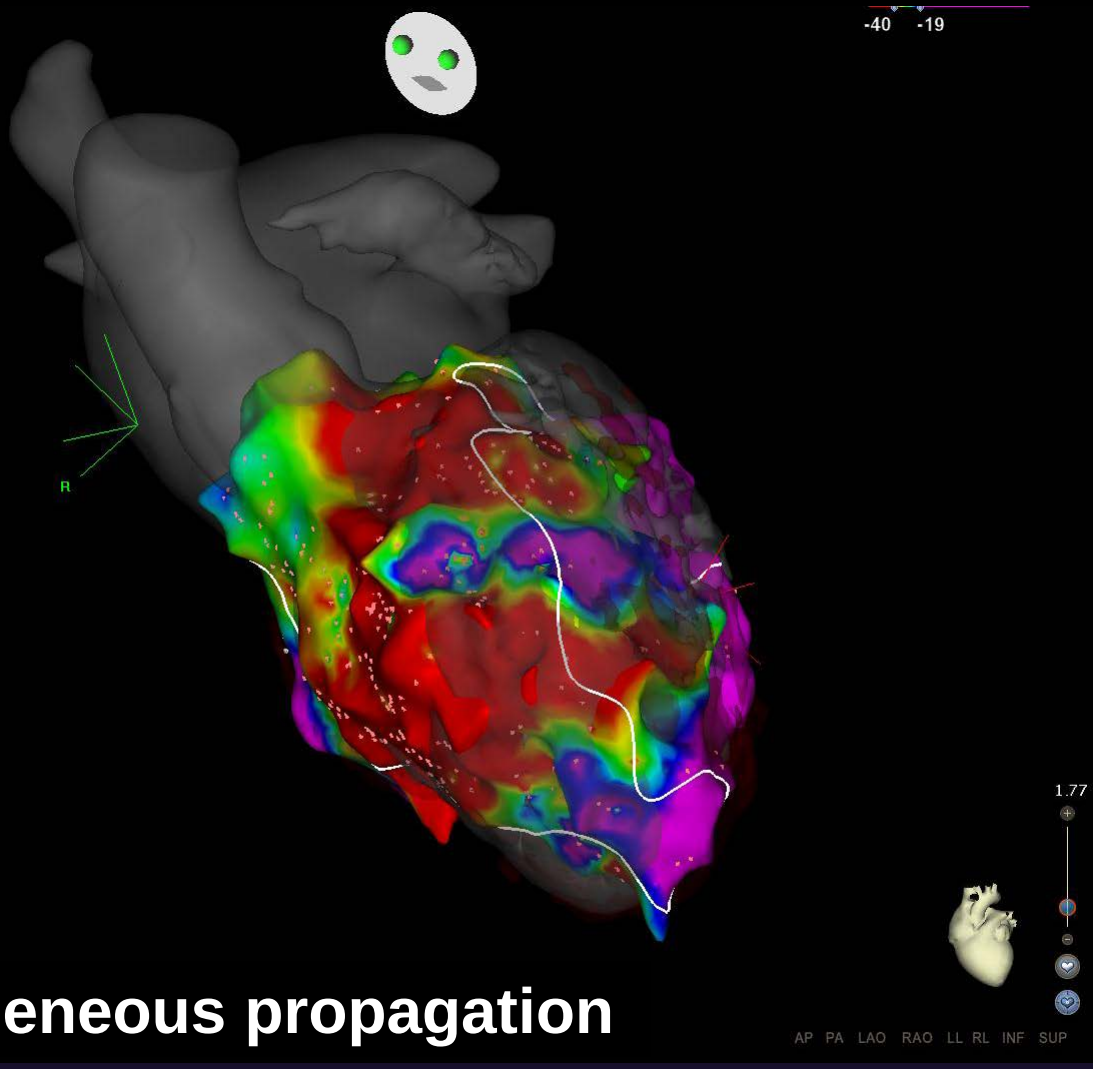


Multiple LV breakthrough (4±3)

Recording of early/preQRS LV EGMs with Purkinje potentials

NICD: preliminary results

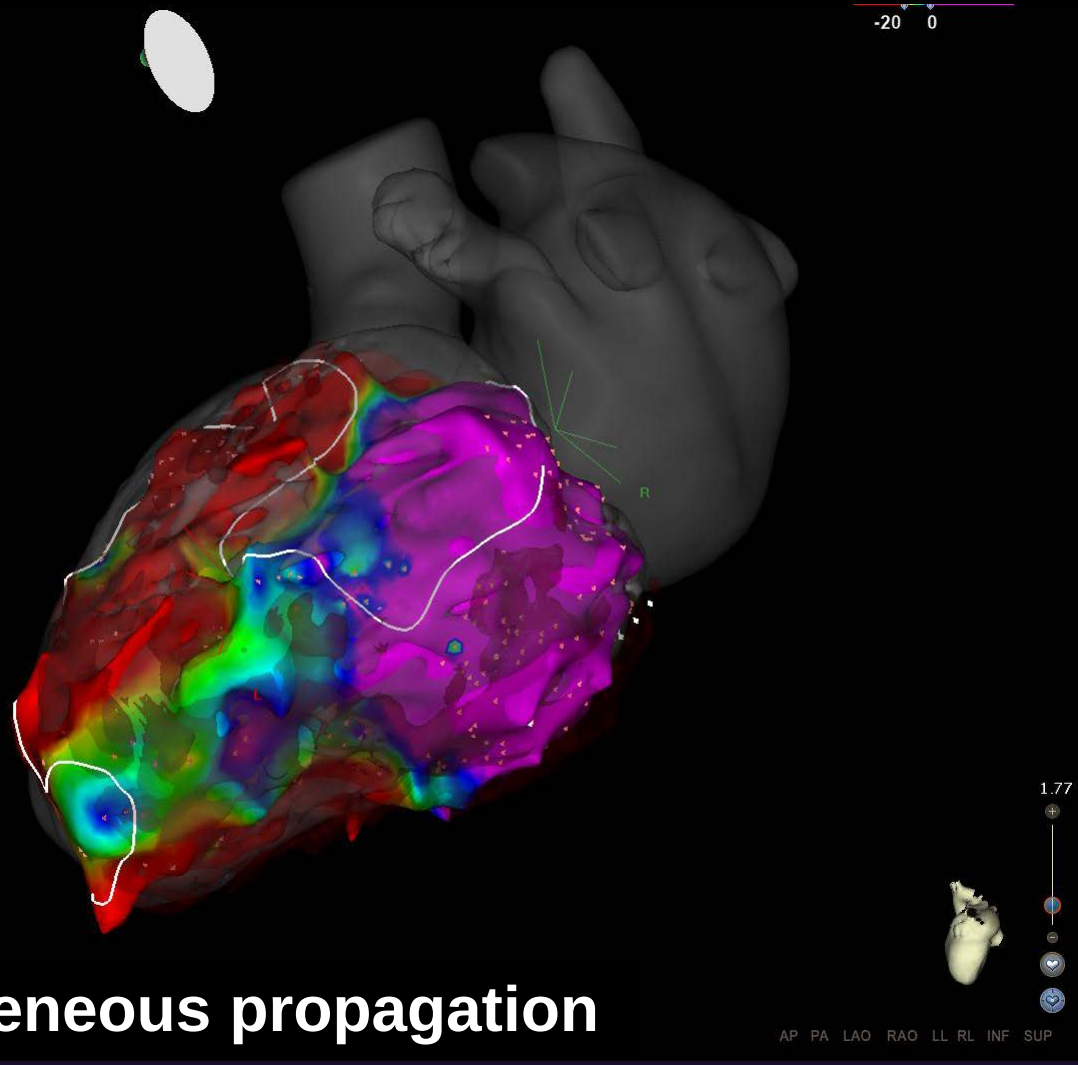
T= 20 à 40ms



Heterogeneous propagation

NICD: preliminary results

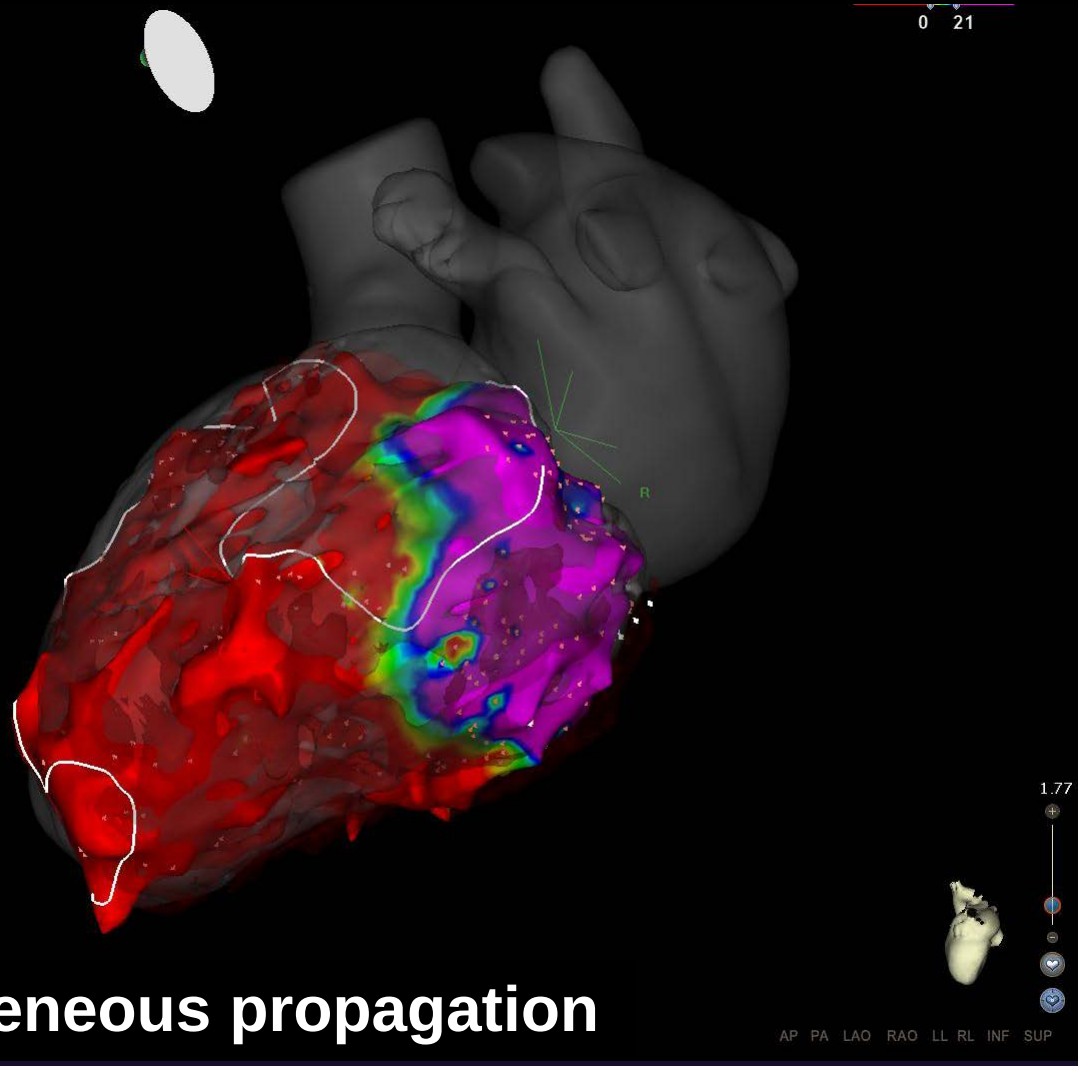
T= 40 à 60ms



Heterogeneous propagation

NICD: preliminary results

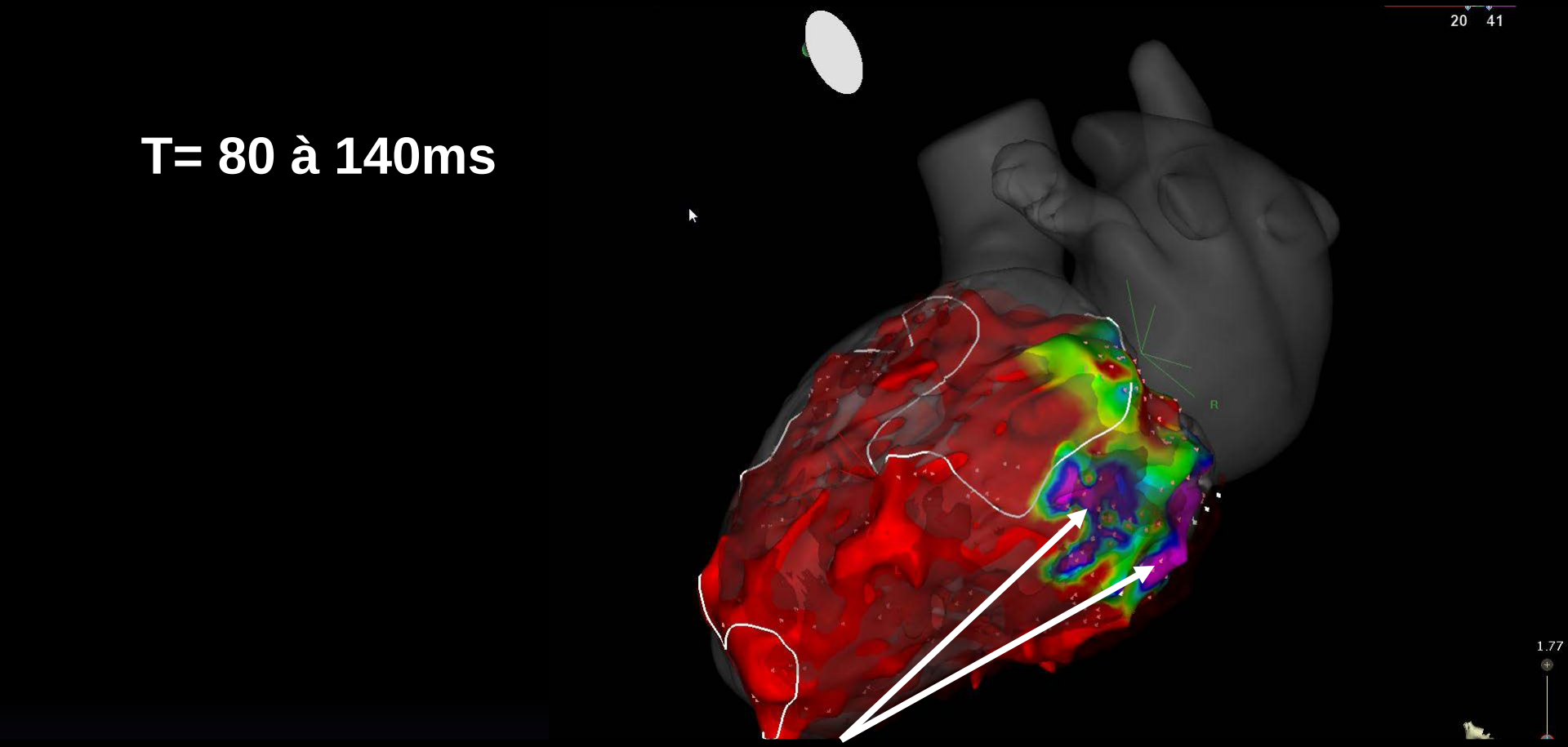
T= 60 à 80ms



Heterogeneous propagation

NICD: preliminary results

T= 80 à 140ms



Areas of late activation

Interindividual heterogeneity in terms of late activated areas

LV activation pattern in patients with narrow QRS, NICD or LBBB

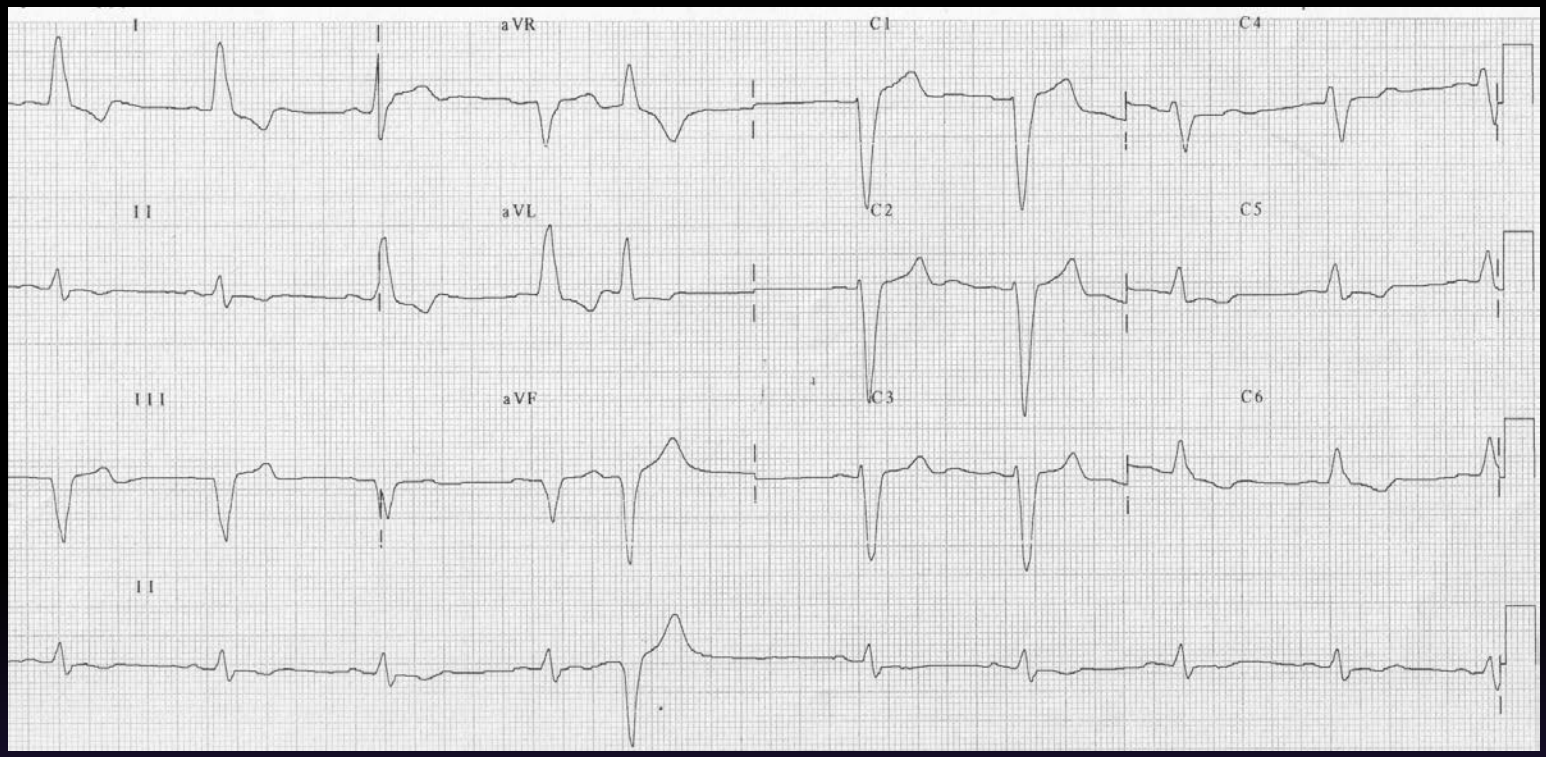
Narrow QRS: homogeneous, multiple breakthroughs, Purkinje, fast propagation

LBBB: homogeneous, single breakthrough, no Purkinje, slow conduction, postero-basal late activation

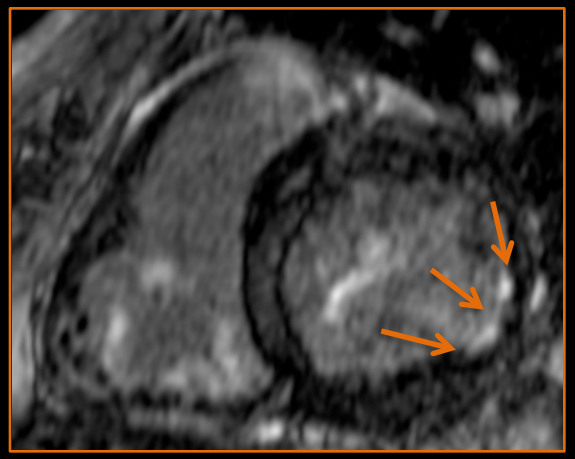
NICD: heterogeneous, multiple breakthroughs, Purkinje, altered propagation

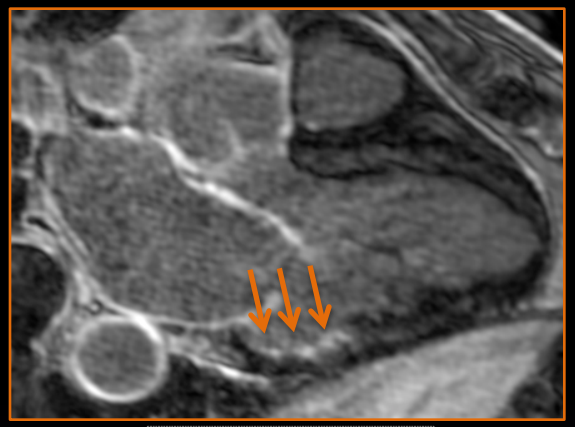
case

74 yo
Non Ischemic DCM
EF 30%

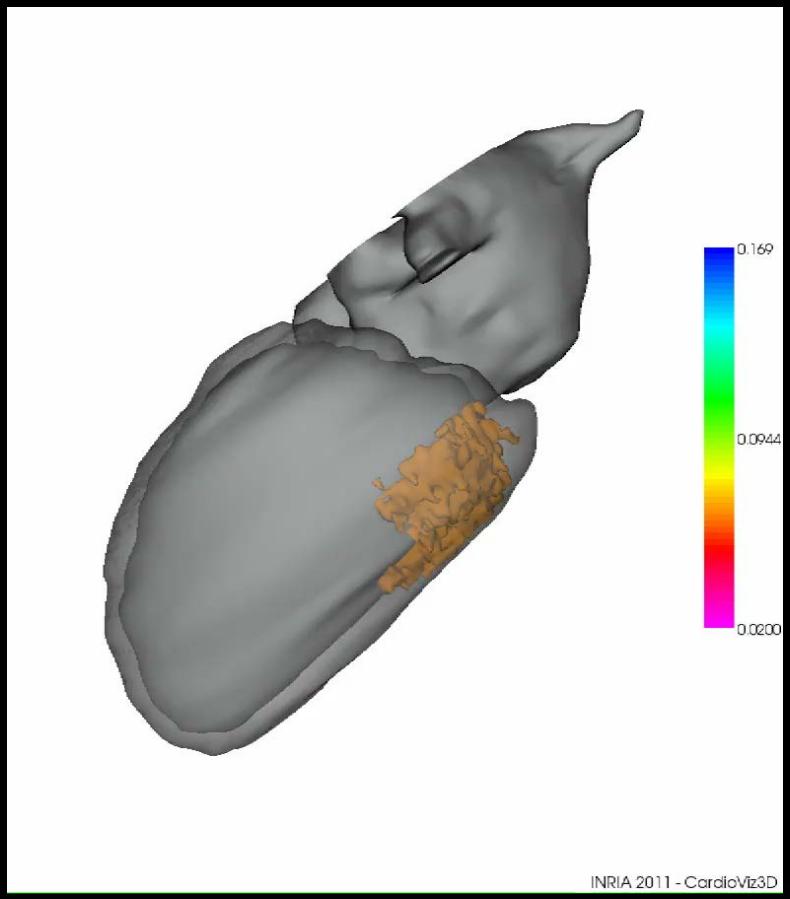


PATIENT 4: CRT

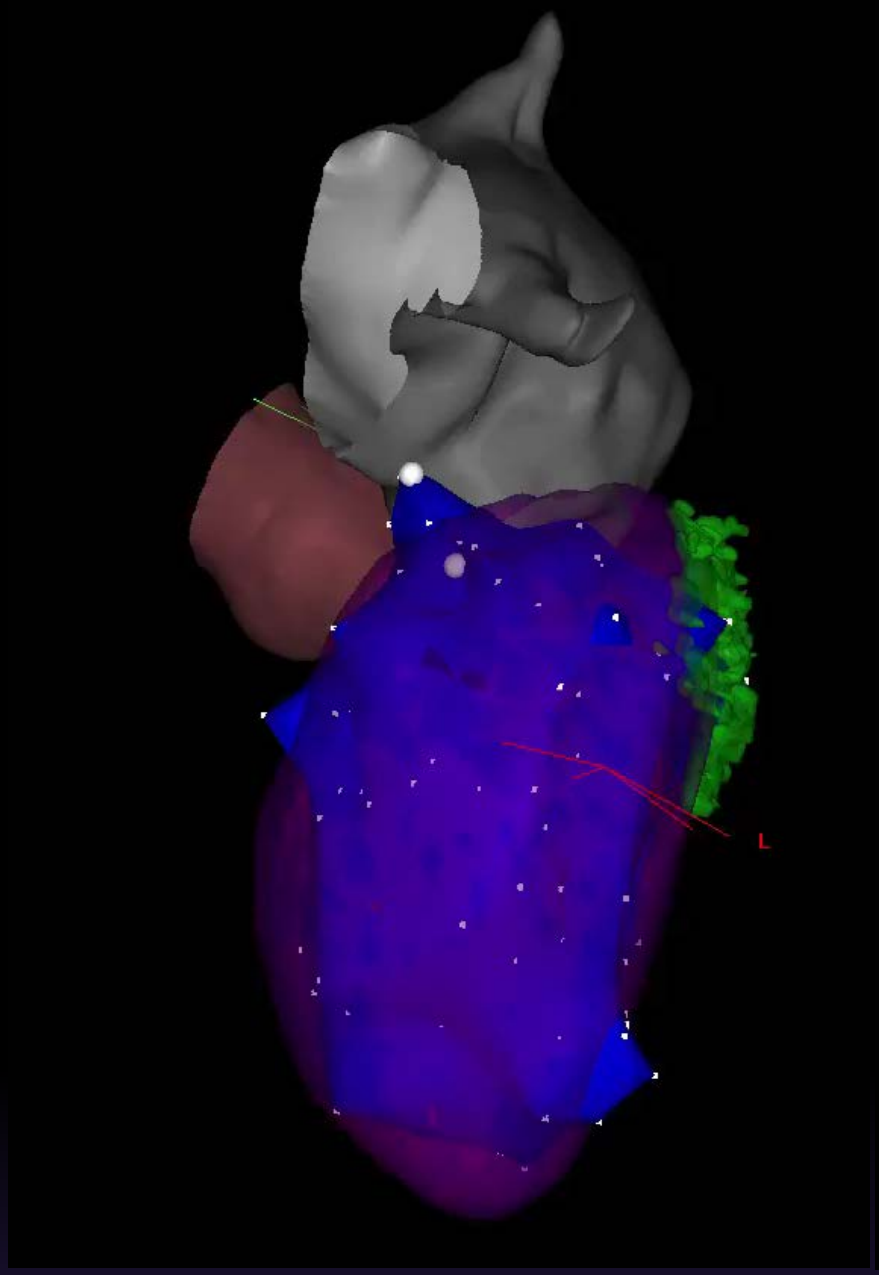


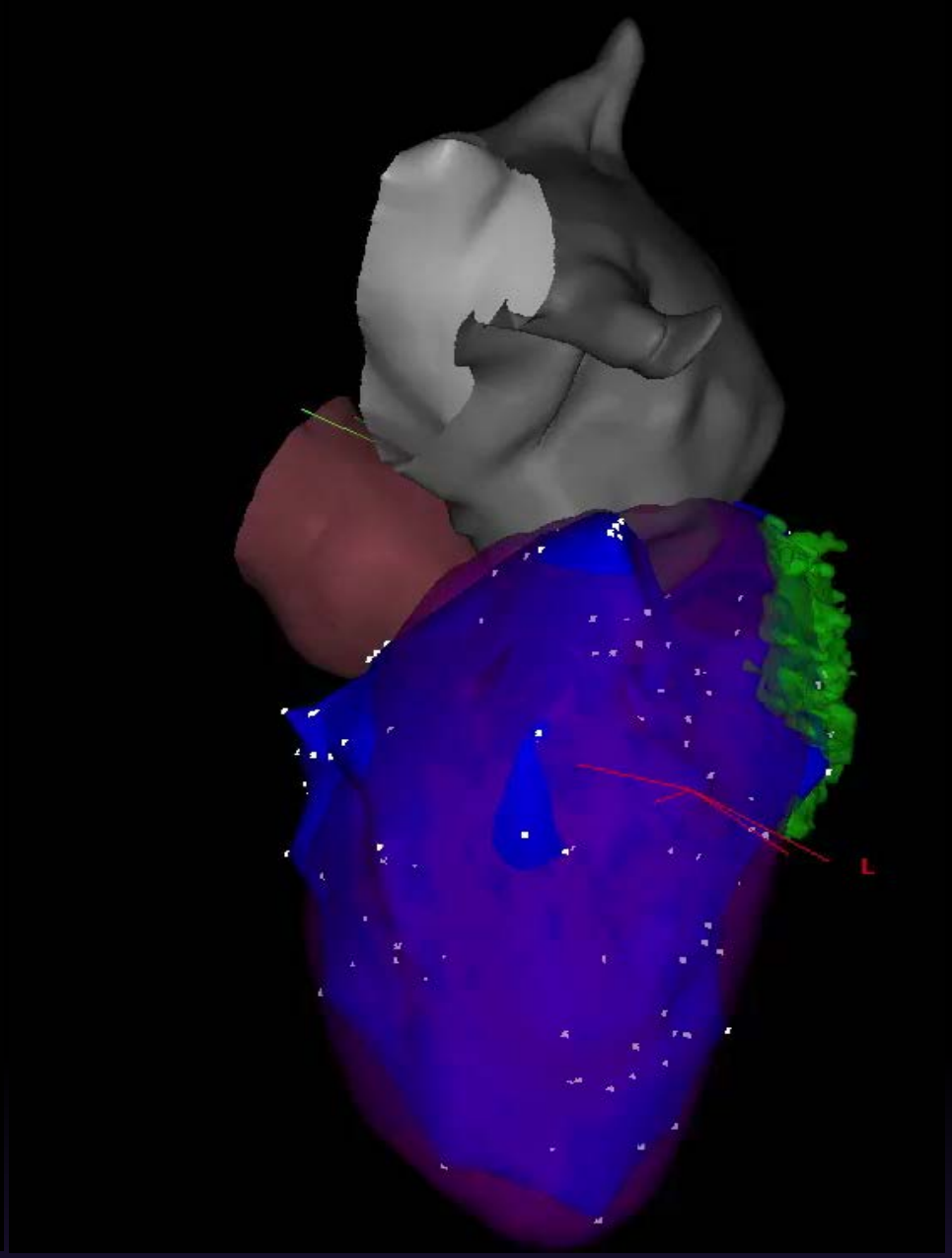


DEMRI



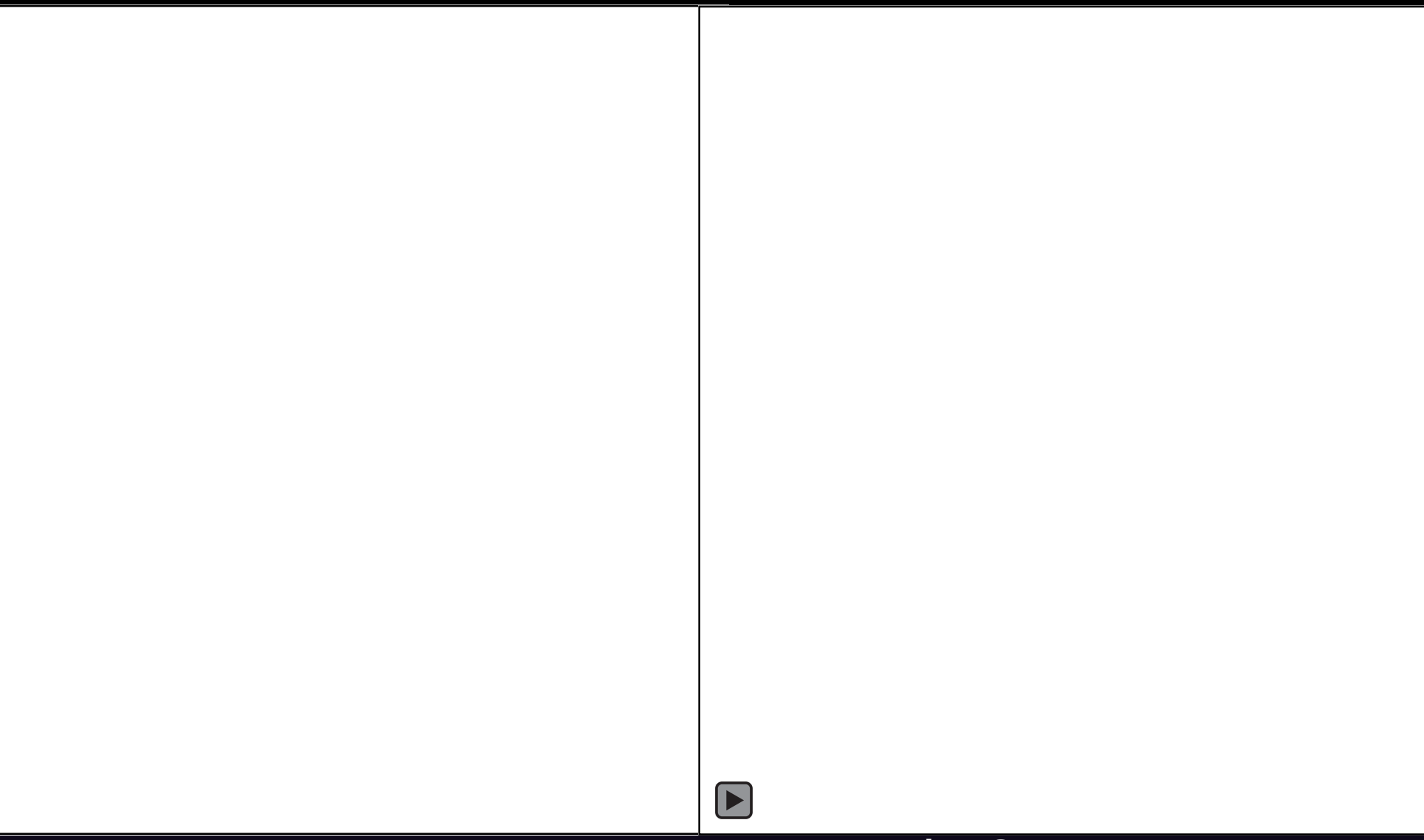
MRI : Sub-endocardial scar in basal infero-lateral segment





BASELINE
LV activation time 90ms

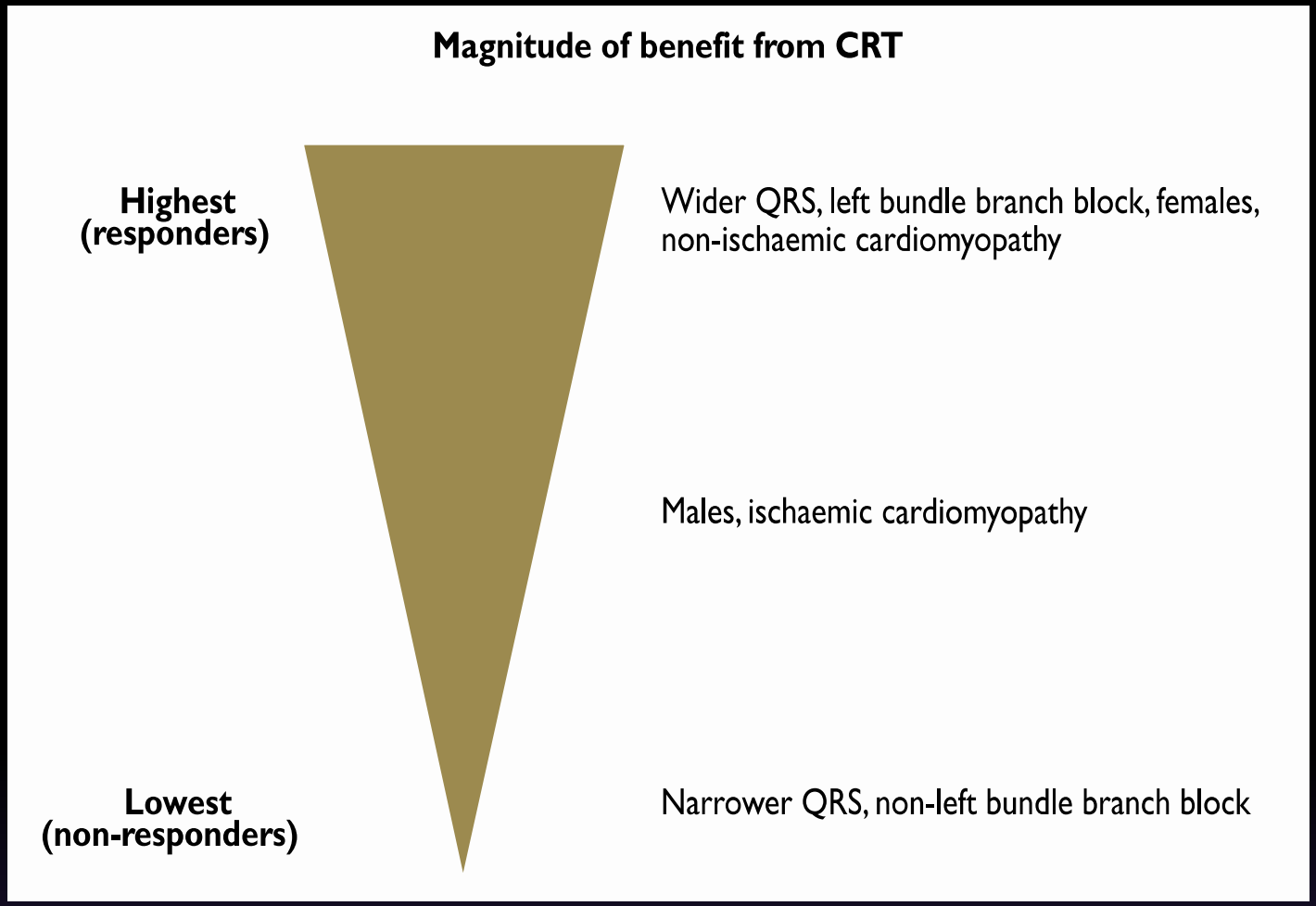
During CRT
LV activation time 111ms (+21ms)



BASELINE
LV activation time 122ms

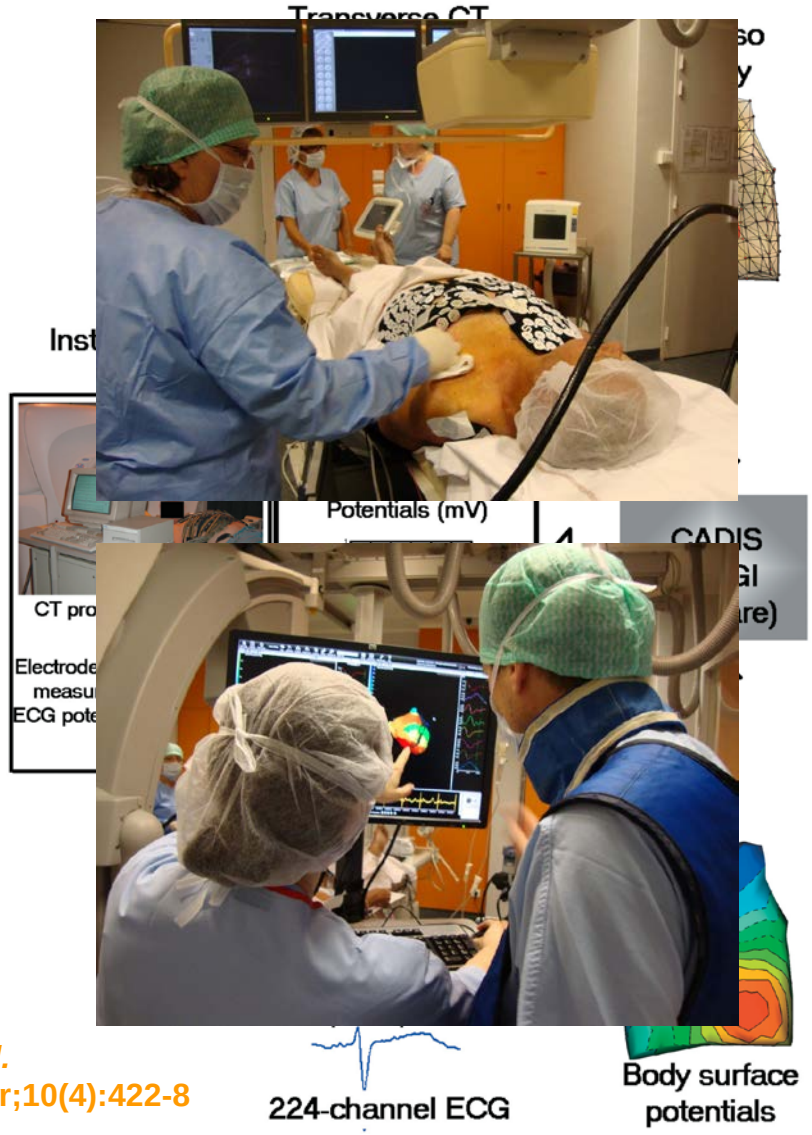
During CRT
LV activation time 55ms (-67ms)

Conclusion

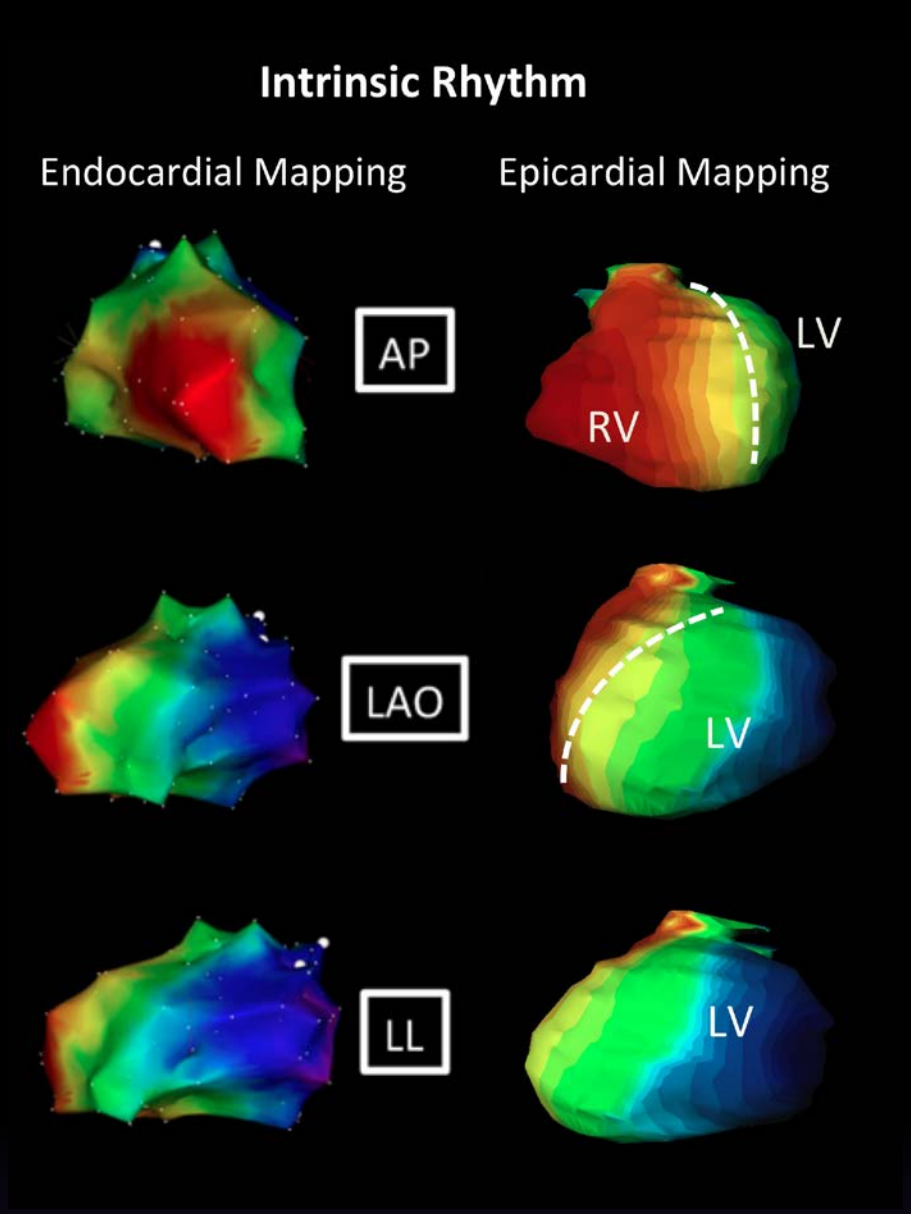

Magnitude of benefit from CRT
Highest (responders)
Lowest (non-responders)
Wider QRS, left bundle branch block, females, non-ischaemic cardiomyopathy
Males, ischaemic cardiomyopathy
Narrower QRS, non-left bundle branch block

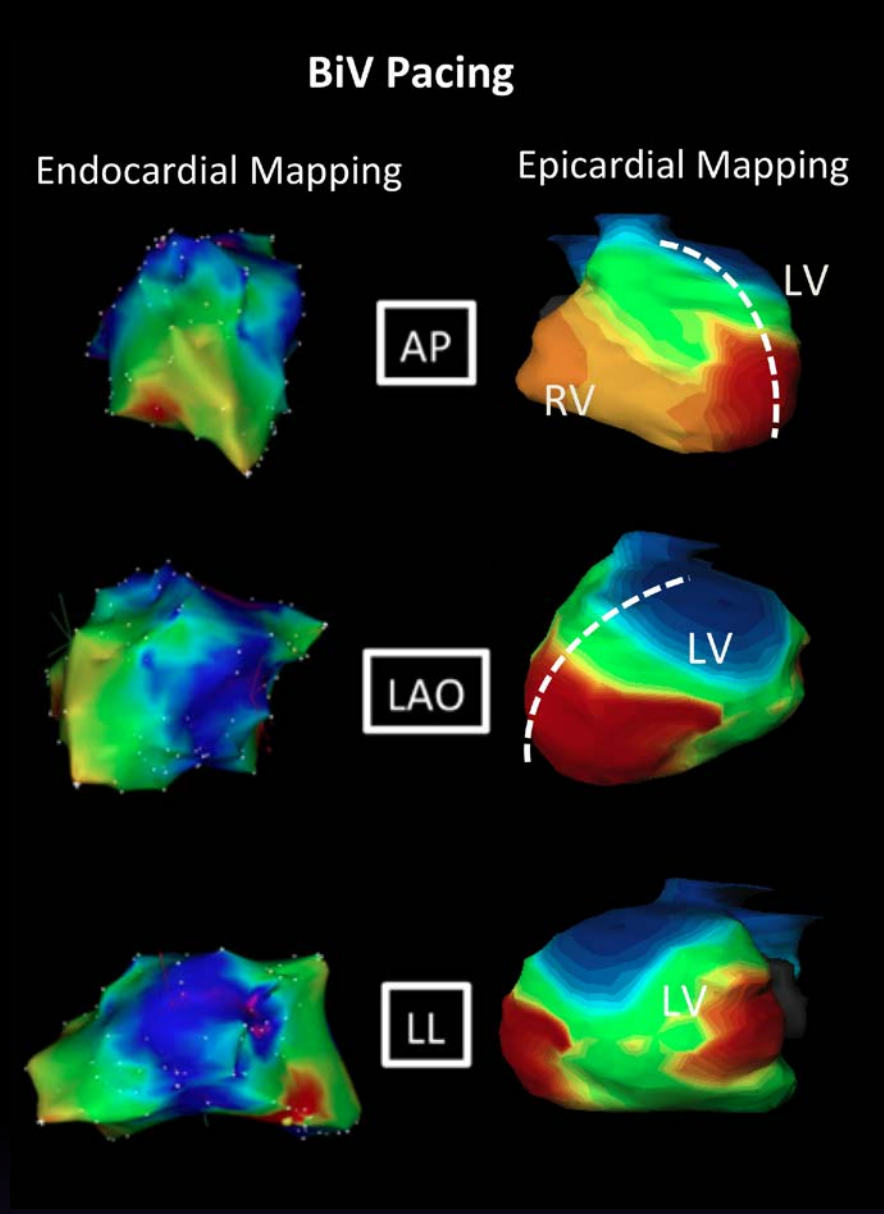
Noninvasive Electrocardiographic Imaging to optimize selection for CRT

cardioInsight

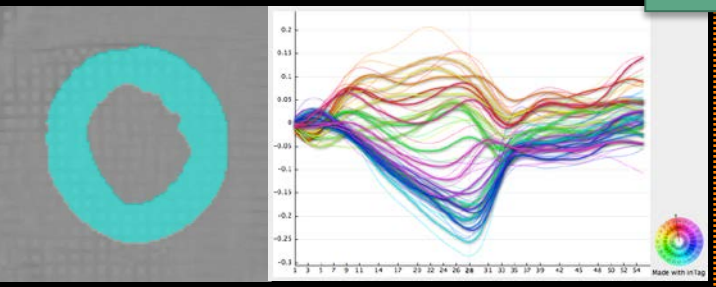


Ramanathan *et al.*
Nat Med. 2004 Apr;10(4):422-8

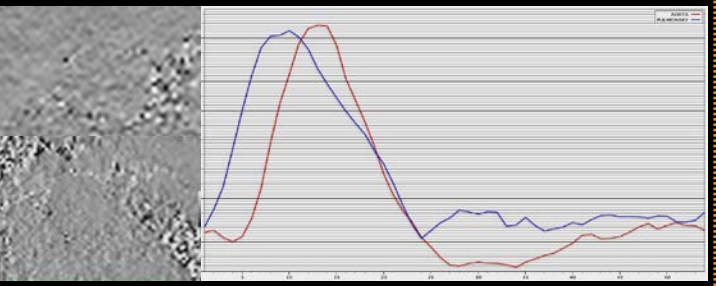




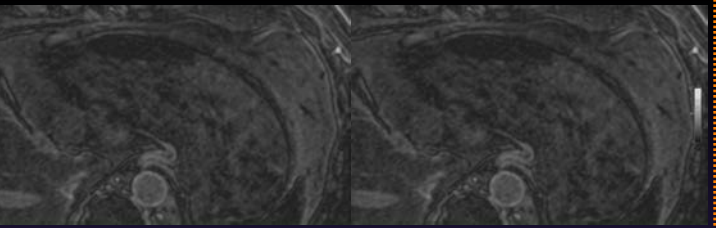
Derval et al. abstract Cardiostim 20



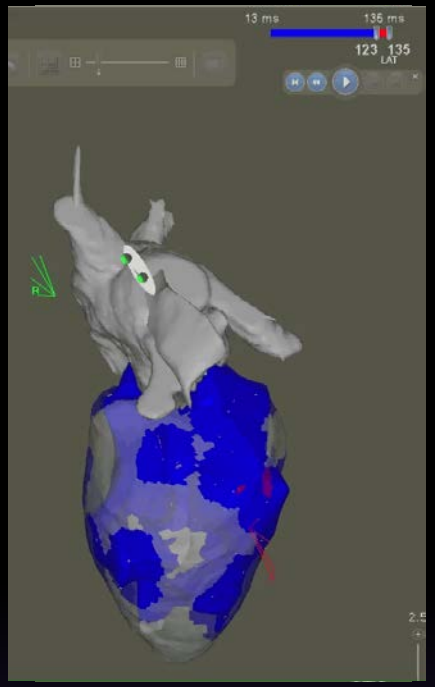
LV mechanical activation



InterV synchrony

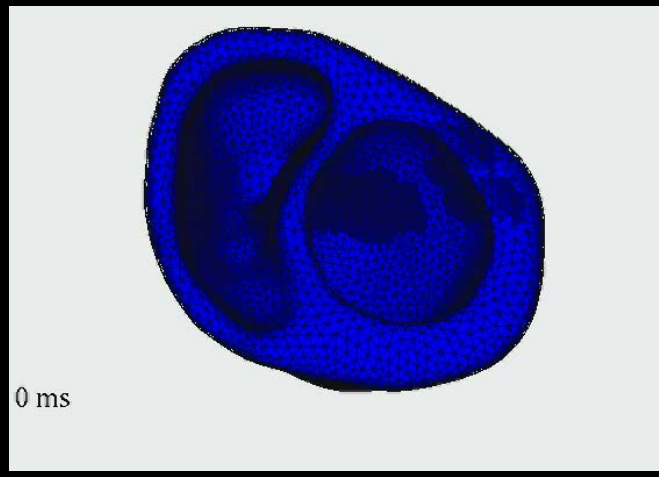


Myocardial fibrosis



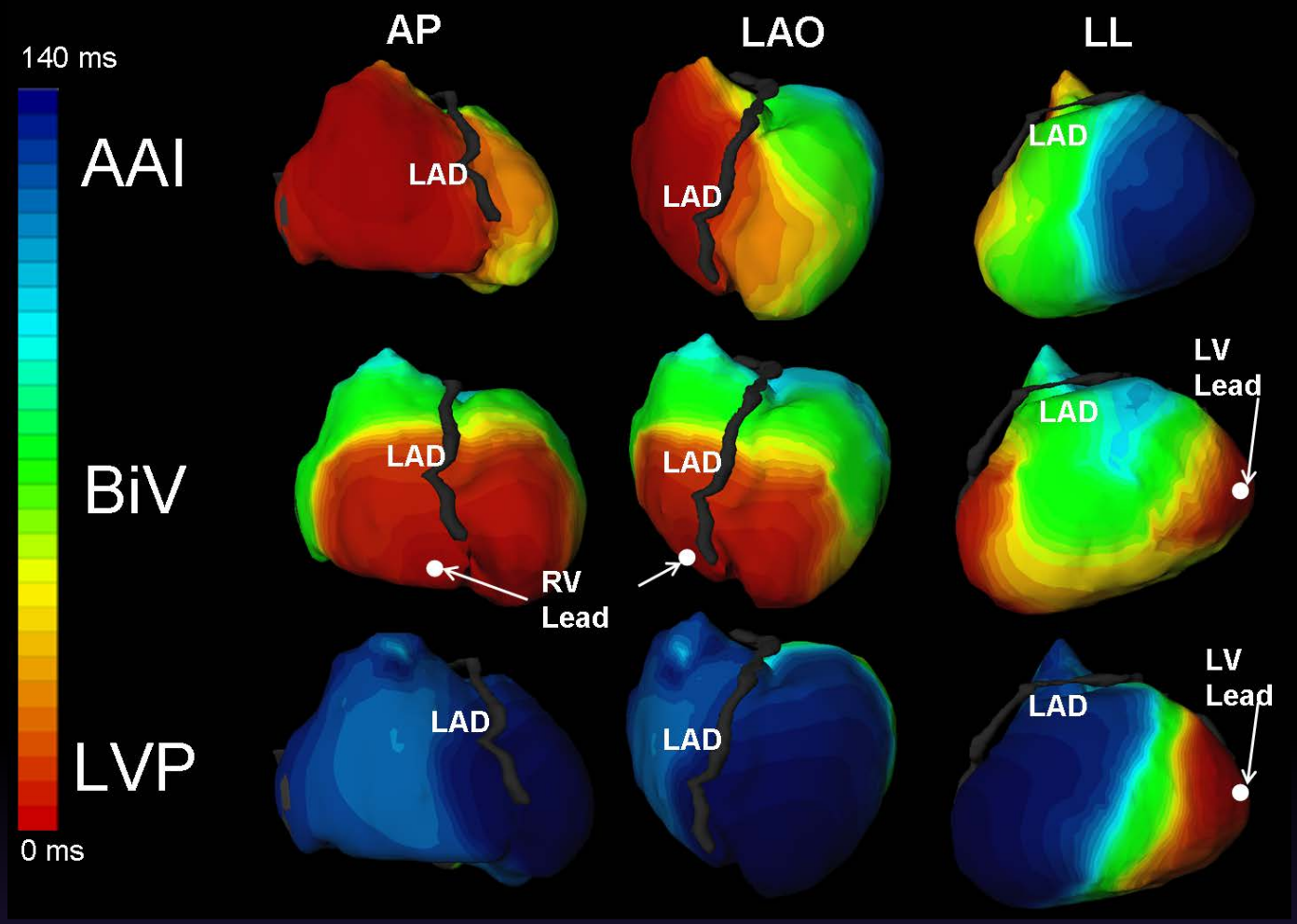
Activation during SR

BiV pacing



Computer modeling / simulation

Direct relation between hemodynamics and dyssynchrony ???



LV dP/dt max

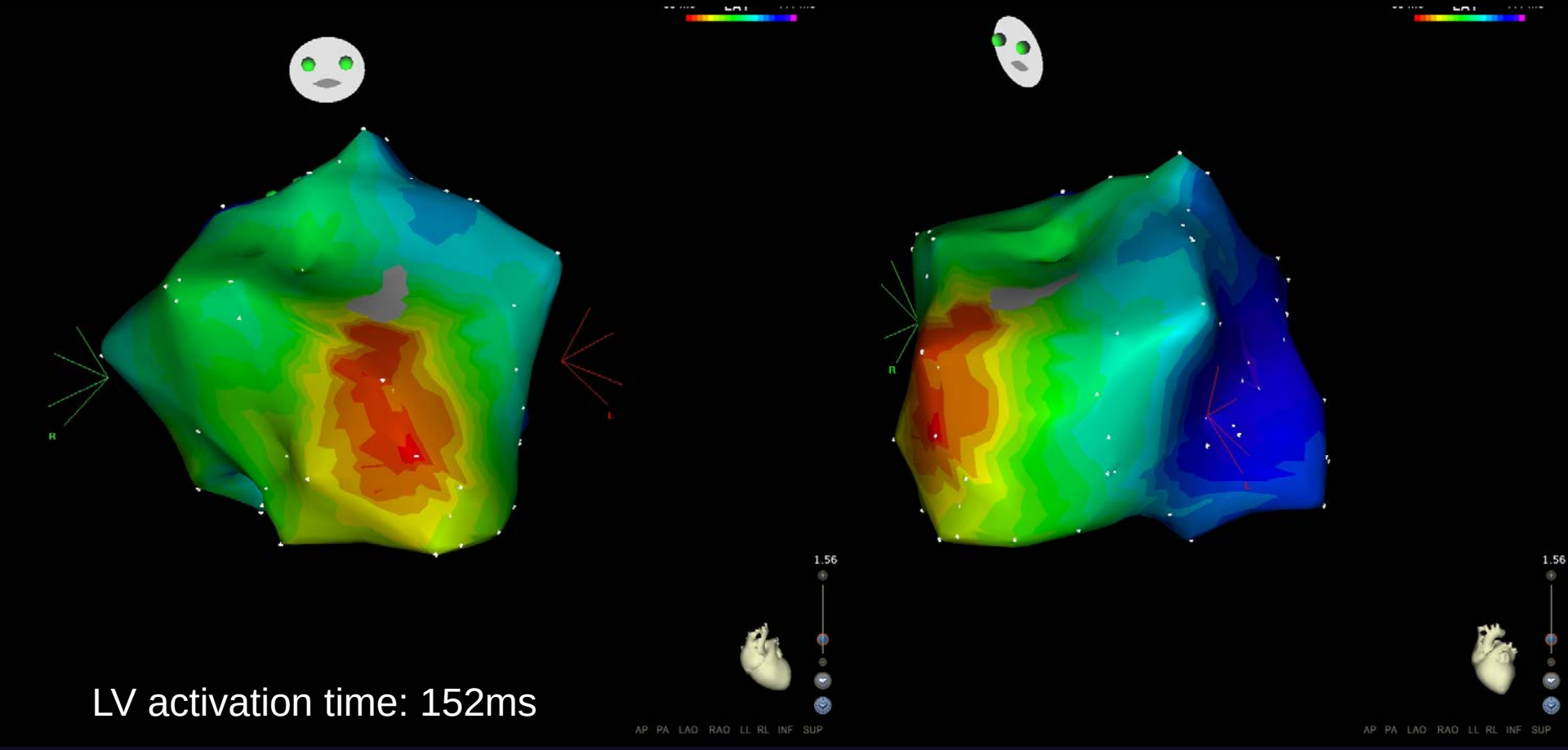
685

934

948

DURING CRT ??

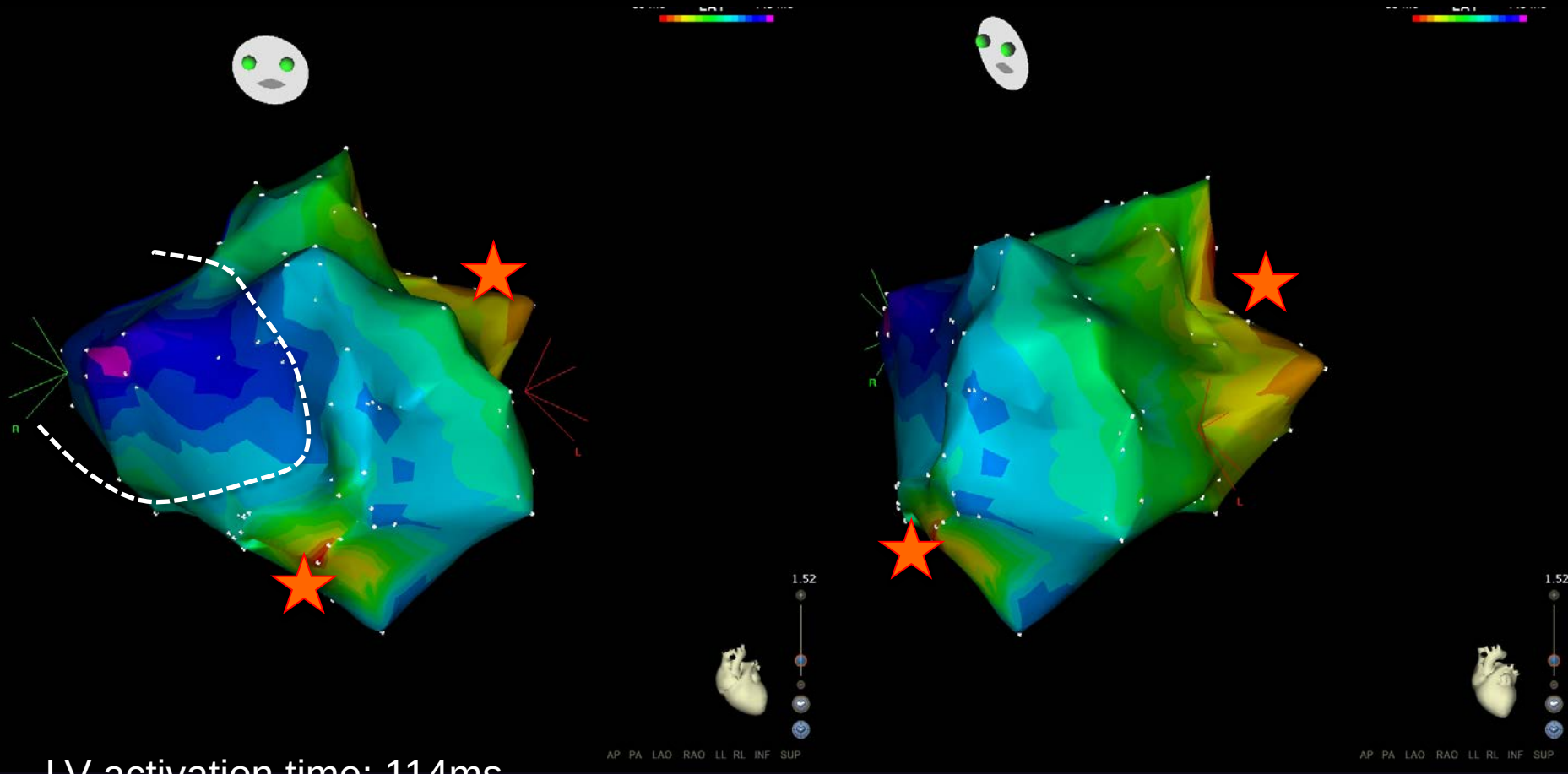
66 yo, EF 22%, NIDCM, LBB 179ms



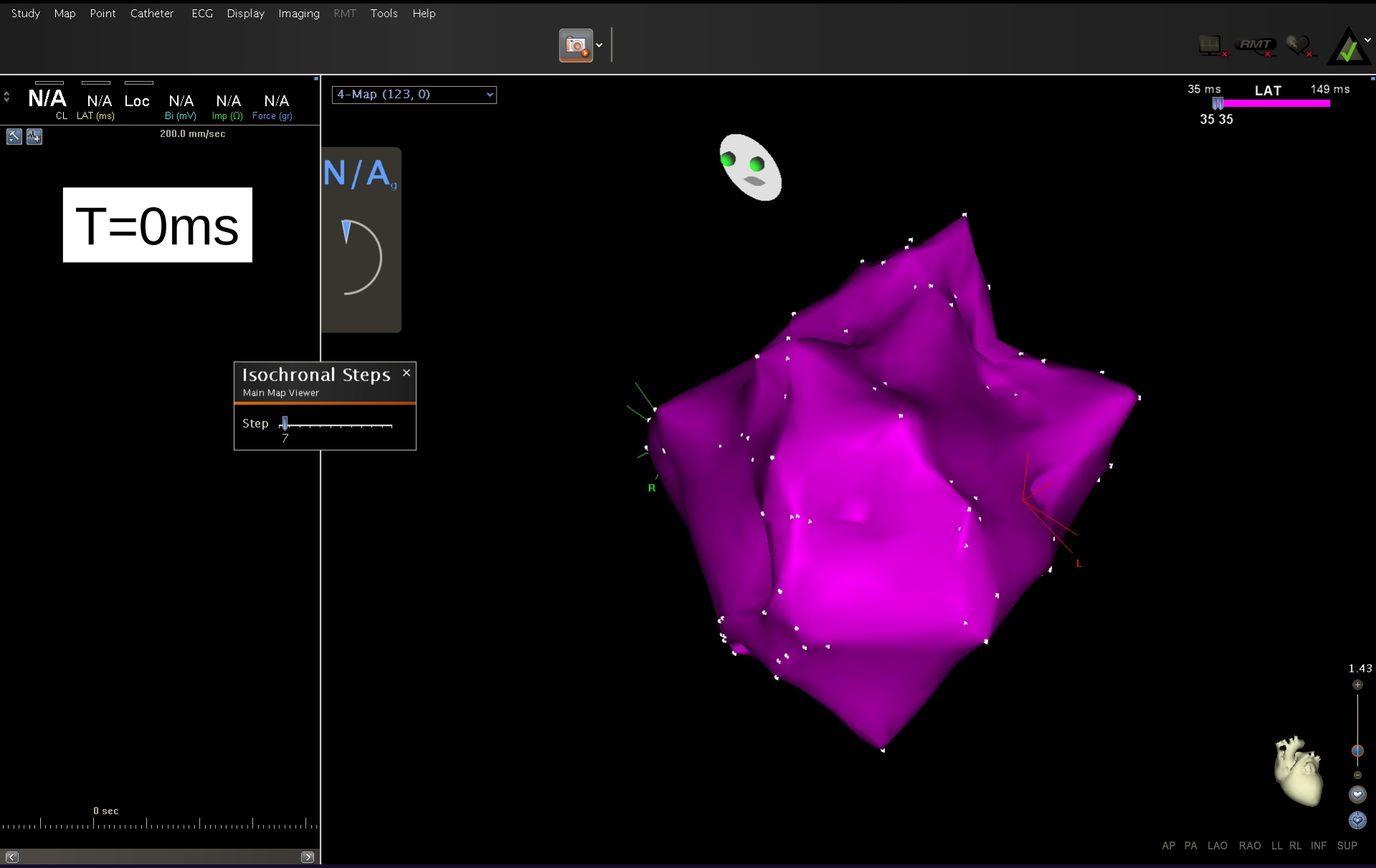
LV activation time: 152ms

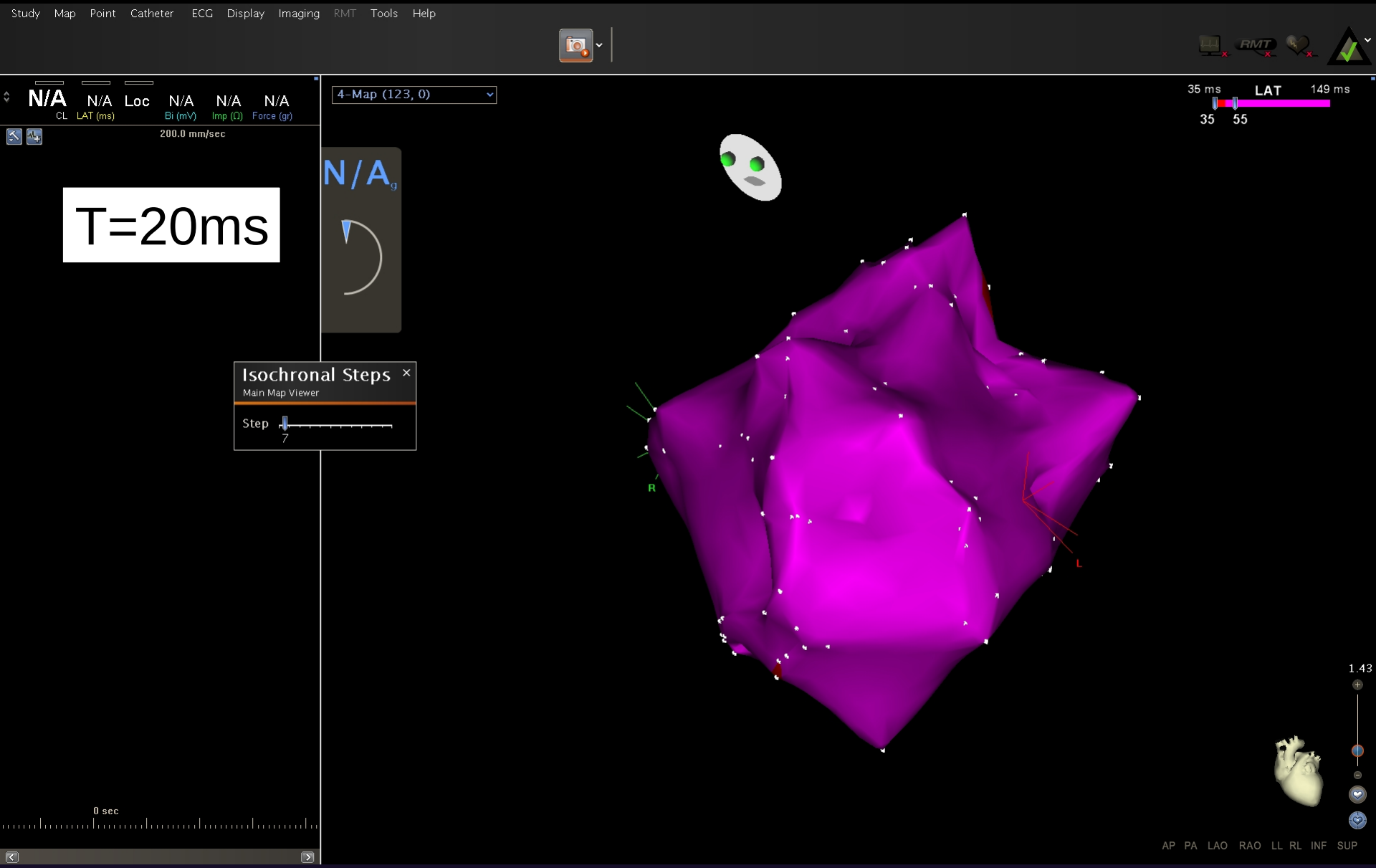
Abstract HRS 2013. Derval et

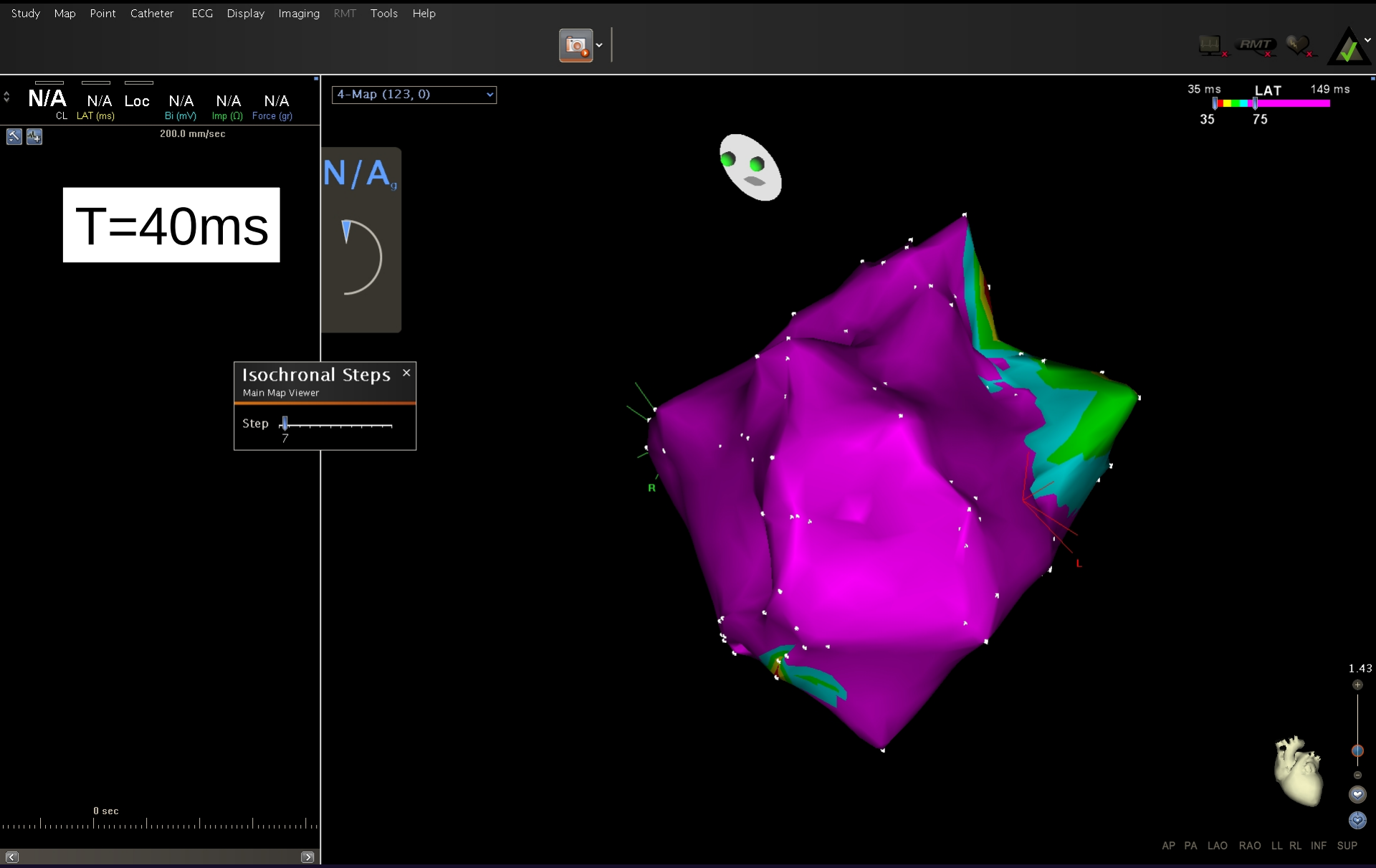
case

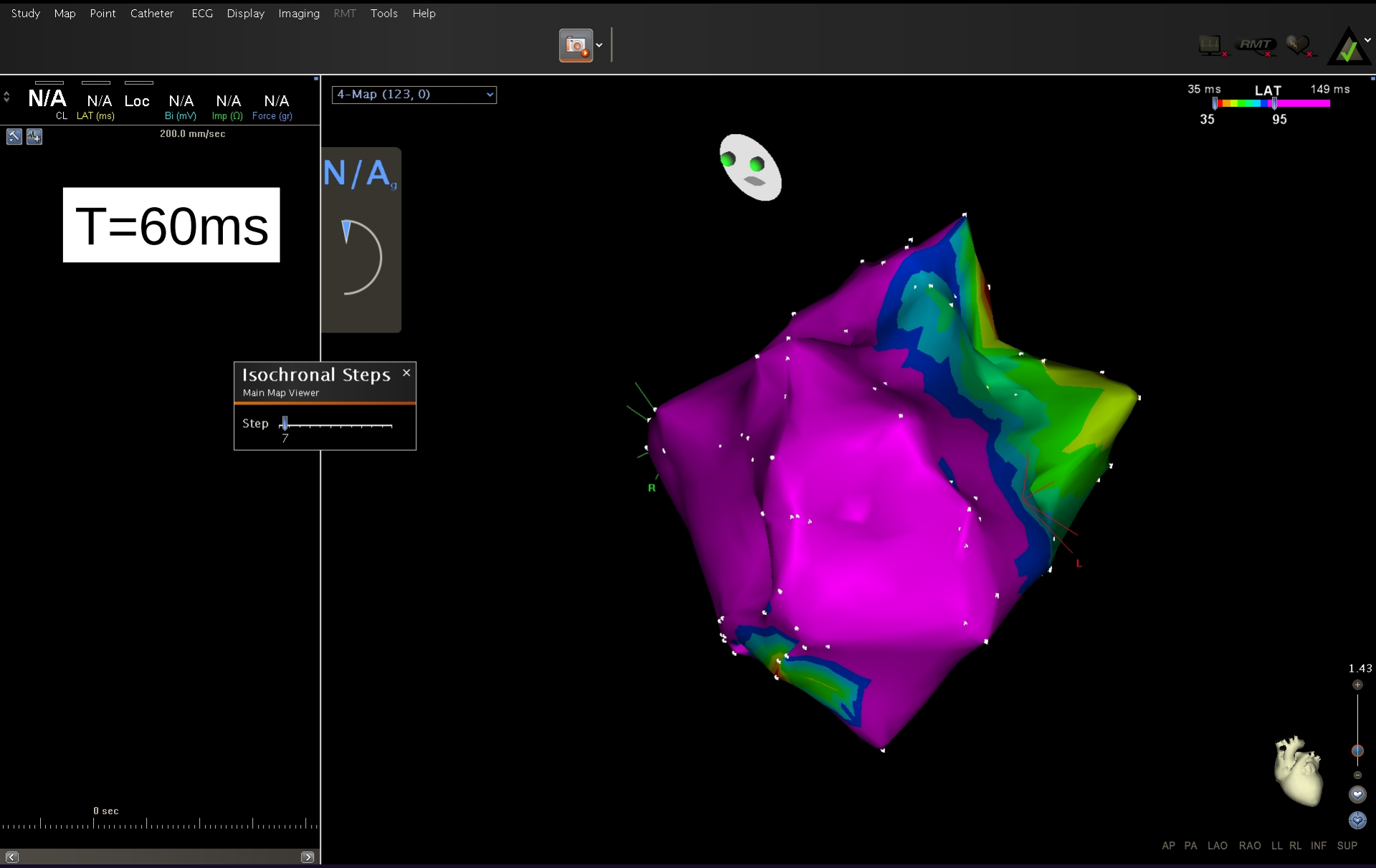


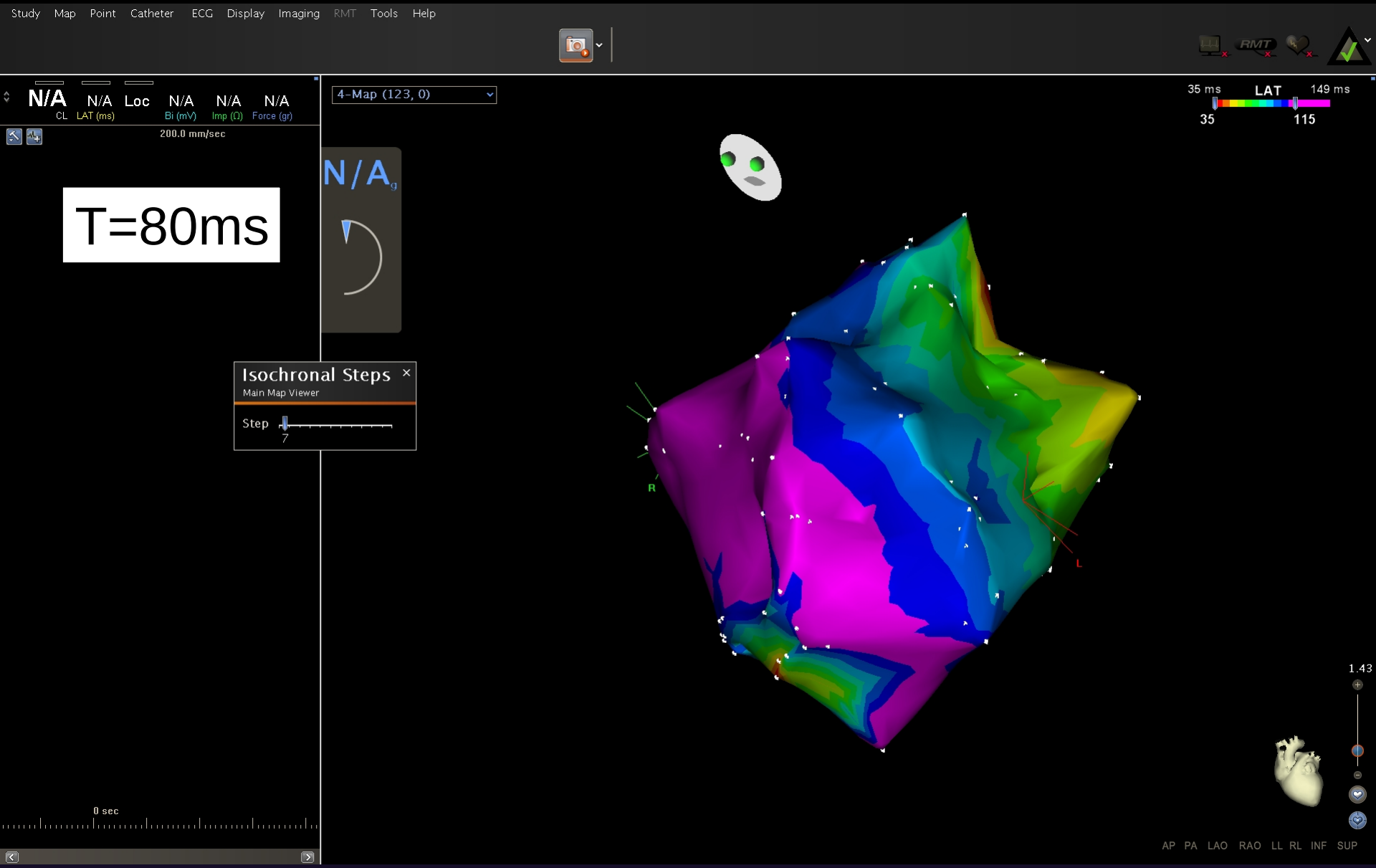
LV activation time: 114ms
+dP/dtmax= +16%

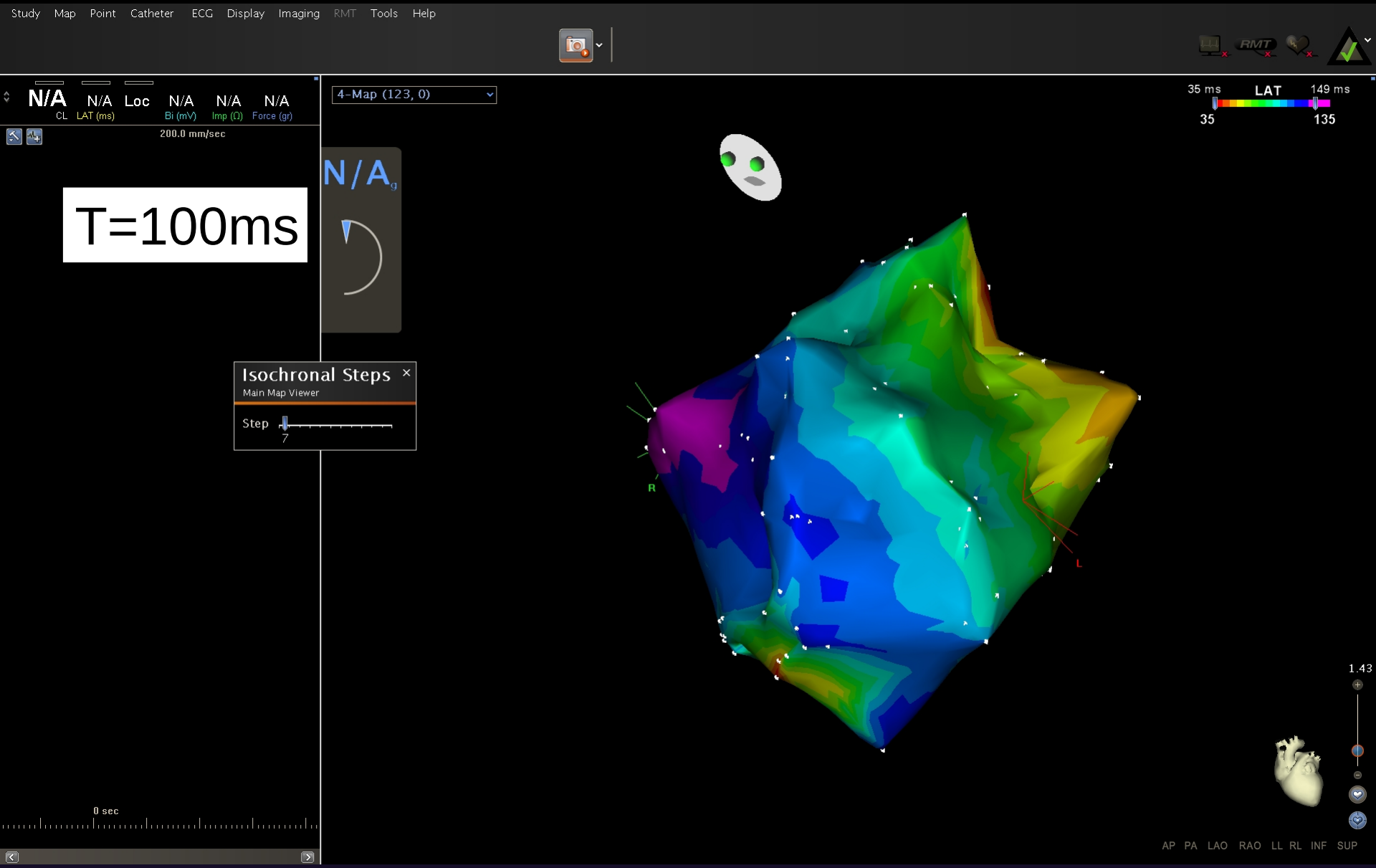

Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=0ms
4-Map (123, 0)
N/A g
Isochronal Steps
Main Map Viewer
Step
7
35 ms
LAT
149 ms
35 35
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP


Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=20ms
4-Map (123, 0)
N/A g
Isochronal Steps
Main Map Viewer
Step
7
35 ms
LAT
149 ms
35
55
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP


Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=40ms
N/A g
4-Map (123, 0)
35 ms
LAT
149 ms
35
75
Isochronal Steps
Main Map Viewer
Step
7
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP


Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=60ms
4-Map (123, 0)
N/A g
Isochronal Steps
Main Map Viewer
Step
7
35 ms
LAT
149 ms
35
95
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP


Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=80ms
N/A g
4-Map (123, 0)
35 ms
LAT
149 ms
35
115
Isochronal Steps
Main Map Viewer
Step
7
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP


Study Map Point Catheter ECG Display Imaging RMT Tools Help
N/A CL
N/A LAT (ms)
Loc
N/A Bi (mV)
N/A Imp (Ω)
N/A Force (gr)
200.0 mm/sec
T=100ms
N/A g
4-Map (123, 0)
35 ms
LAT
149 ms
35
135
Isochronal Steps
Main Map Viewer
Step
7
R
L
1.43
0 sec
AP PA LAO RAO LL RL INF SUP